CHAPTER 2 - ALTERNATIVES INCLUDING THE PROPOSED ACTION

The purpose of this chapter is to present the alternatives that were considered. The discussion is divided into two sections—alternatives considered but eliminated from further study and project alternatives studied in detail.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER STUDY

Several alternatives to the proposed action were analyzed in detail but eliminated from further study because they do not meet the purposes and needs of the project. These alternatives included (1) energy conservation and electric load management; (2) new generation facilities; (3) existing transmission systems; and (4) alternative transmission technologies (voltage levels, direct or alternating current, underground, and new transmission technologies).

ENERGY CONSERVATION AND ELECTRIC LOAD MANAGEMENT

One alternative to building a new transmission line would be to promote energy conservation among consumers in the project area. The National Energy Policy Act of 1992 made provisions for a wide range of energy conservation measures, including a number of incentives for energy conservation, load management, and the development of energy standards and electric equipment standards. The National Energy Policy Act also provides incentives for renewable energy developments and the commercialization of energy technologies (such as biomass programs), as well as providing for many different programs to promote efficiency, generation and use, coal and petroleum use, clean fuels, and others.

As an example, Western's Energy Planning and Management Program (EPAMP) was initiated at about the same time as the National Energy Policy Act. The goal of EPAMP is to encourage power and energy customers to consider cost-effective demand-side and supply-side options, renewable energy alternatives, and efficiency.

Despite the National Energy Policy Act and programs such as Western's EPAMP, this alternative meets only a small part of the purposes and needs for NTP. Specifically, this alternative would manage to forestall the increase in regional energy demands for only a short period of time, while having no effect on the transmission system constraints west of the Four Corners area or on the economic condition of the people of the Navajo Nation. Furthermore, it is anticipated that the relief of energy demands brought about by this alternative would be minimal at best because most of the market area, such as southern California and southern Nevada, already has aggressive energy conservation and load management programs in effect.

Because this alternative failed to meet the purposes and needs for NTP and because the projected benefits are anticipated to be minimal, this alternative was deemed to be unacceptable as an alternative to constructing NTP.

NEW GENERATION FACILITIES

Building new generation facilities would help meet the increasing energy needs of the southwestern United States and, depending on the location of the project, could conceivably benefit the Navajo Nation. However, any new generation facilities built would not remove the transmission system constraints west of the Four Corners area and, in fact, would aggravate the situation. Not only is new transmission needed to remove existing constraints, but additional new transmission would be needed to accommodate new power generated. Also, construction of any new generation facility would not be able to lend itself to seasonal or regional energy exchanges because there would still be a lack of adequate transmission capability. For these reasons, this alternative was not considered further.

EXISTING TRANSMISSION SYSTEMS

The alternative of using the existing transmission systems included evaluation of the following: (1) scheduling power from the Four Corners area to major load areas via different electrical transmission paths, (2) using a phase shifting transformer or transmission line compensation on the existing transmission paths, and (3) upgrading Western's 230kV line.

As previously explained, all of the electrical paths out of the Four Corners area are often used to the maximum capacity. This results in "trapped" generation in the Four Corners area, meaning that there is more generation capacity than can be safely transmitted out of the area. Scheduling power across alternate transmission paths and through multiple systems owned by different utilities results in increased losses. These losses coupled with the costs of wheeling over multiple systems become cost prohibitive.

Another consideration evaluated was using a power-control device such as a phase shifter or series compensation. This does not mitigate the basic problem of lack of capacity available on the existing transmission system.

Over the past several years Western has implemented upgrades to maximize the capability of its Shiprock-to-Glen Canyon 230kV transmission line to the extent practicable, thereby postponing participation in a major project such as NTP. During this same time, however, Western has considered several options for providing the additional power transfer capability needed across the 230kV line while maintaining acceptable voltage levels at the Kayenta and Long House Valley substations. Options evaluated included uprating the line to a higher voltage level, reconductoring the line (which would take the line out of service for six to nine months), wheeling power through agreements with other utilities, and adding a series of shunt capacitors. Cost was considered prohibitive as a long-term solution for all but the option for series capacitors. Series capacitors were installed at the Kayenta Substation in 1992, improving the flowability of the Shiprock-to-Glen Canyon line from 240 MW to about 350 MW, while keeping voltage levels at Kayenta and Long House Valley substations within acceptable limits. However, this was a short-term improvement overall.

In summary, this alternative has a very low benefit-to-cost ratio. The minimal benefits obtained would come at a high cost. As such, no further consideration was given to this alternative.

ALTERNATIVE TRANSMISSION TECHNOLOGIES

Alternative Voltage Levels

It is possible that the stated purposes and needs for NTP could be met by designing for voltage levels other than 500kV. However, adjusting the voltage level would result in either increased costs for construction (at higher voltage levels) or compromising capacity (at lower voltage levels).

If NTP were to be constructed at a higher voltage, such as 765kV, the estimated cost of construction would be up to 1.75 times the cost of constructing NTP at 500kV. A 765kV line would require taller structures, larger conductors, increased insulation of equipment, wider right-of-way, and larger-sized equipment. In addition, electrical system studies have shown that voltage levels higher than 500kV do not result in higher capacities without significant facility additions to the existing systems. Constructing NTP at less than 500kV would result in less transmission capacity than the amount projected to be needed and would accomplish fewer of the benefits sought by the project proponents (less potential revenue). The magnitude of these disadvantages led to the decision to choose construction of NTP at the 500kV level.

Direct or Alternating Current Transmission

The benefit of a direct current (DC) system is greater control of power flows over long distances. However, a DC system does not provide much flexibility for interconnections with alternative current (AC) systems. To interconnect with an AC system, the DC must be converted to AC. Converter substations are very expensive and require more land than a typical AC substation. An AC system can be interconnected with existing systems more economically. For these reasons, the AC design for NTP was chosen over a DC design.

Underground Transmission

Some high-voltage underground lines (115kV or above) have been constructed, but only for short distances, and usually where circumstances dictated that overhead lines were not feasible (e.g., in the vicinity of airports and urban centers).

High-voltage underground transmission lines have markedly different technological requirements than lower-voltage underground distribution lines. For example, underground high-voltage transmission lines require extensive cooling systems to dissipate the heat generated by the transmission of bulk electricity. Cooling systems are complex and very expensive. The extremely high cost of large cooling systems and other special design requirements are prohibitive for long distance electric transmission. Currently, the only underground transmission systems in the United States that are 230kV or larger are 25 miles or less in length. In addition, the basic cost of constructing a high-voltage transmission line underground would be several times more than the cost of overhead transmission line construction. Underground systems would require a pipeline and aboveground ancillary facilities such as oil-pressurizing and pumping stations, and cooling stations to transport cooling oil along the transmission line. Oil pumping and cooling facilities would be required at the originating and terminating substations, and approximately every 7 to 10 miles along the transmission route (more frequently in hilly or mountainous terrain).

While underground transmission lines are relatively immune to weather conditions, they are vulnerable to washouts, seismic events, cooling system failures, and incidental excavation. Outages for underground lines could last days or weeks while the problem is being located and repaired. Typically, failures in overhead lines can be located and repaired in a matter of hours. Long-term outages would be unacceptable for a circuit carrying bulk power.

Negative environmental impacts from construction of an underground transmission line would be similar to those for major pipeline construction. Typical construction would require a continuous trench between endpoints resulting in ground disturbance along a partial right-of-way. By comparison, overhead transmission line construction typically results in partial disturbances of the right-of-way only at individual tower or substation sites and in areas providing access to the right-of-way. Further, a major cooling system failure could result in coolant spills.

In summary, because of the technical complications, economic cost, environmental impacts, and accessibility for maintenance, an underground system was not considered a viable alternative and was eliminated from further consideration.

New Transmission Technologies

Other technologies considered as alternatives for economical bulk-power transmission of electric energy to load centers were microwave, laser, and superconductors. Current research and development indicates some of these technologies eventually may become viable alternatives to overhead transmission systems; however, none of them are currently available for commercial use. Therefore, new transmission technologies were eliminated from further consideration for this project.

ALTERNATIVES STUDIED IN DETAIL

Project alternatives studied in detail included no action and the proposed action, including alternative transmission line routes.

NO-ACTION ALTERNATIVE

If no action is taken, the right-of-way for NTP would not be granted and the transmission line would not be constructed. Advantages of the no-action alternative would include the saving of construction costs of new facilities and the preclusion of associated impacts on the environment. However, the needs for the project, as explained in Chapter 1, would not be met. Constraints on the transmission of electricity in the area would not be relieved; operational flexibility and reliability would not be improved; and economical power transfers, sales, and purchases in the area would not increase. In addition, the Navajo

Nation would have to seek other means to attempt to improve its economic conditions and develop energy resources.

PROPOSED ACTION

DPA is proposing to construct, operate, and maintain a 500kV AC transmission line from Western's Shiprock Substation west of Farmington in northwestern New Mexico across northern Arizona to either the Marketplace Substation or Western's Mead Substation, both of which are located in southern Nevada. The needs stated in Chapter 1 would be met by this proposed action.

The following sections describe the proposed action including the transmission line, substation, and communication facilities; right-of-way acquisition; construction activities (e.g., survey, access roads, clearing, tower installation, conductor stringing, cleanup, and reclamation); and operation, maintenance, and abandonment. The alternative routes studied for the DEIS including the environmentally preferred are discussed later in this chapter. However, a final preferred route has not been selected by the lead and cooperating agencies in cooperation with DPA as of the date of this DEIS. A decision on the final preferred route will be documented in the Record of Decision following the final EIS (FEIS).

Transmission Line

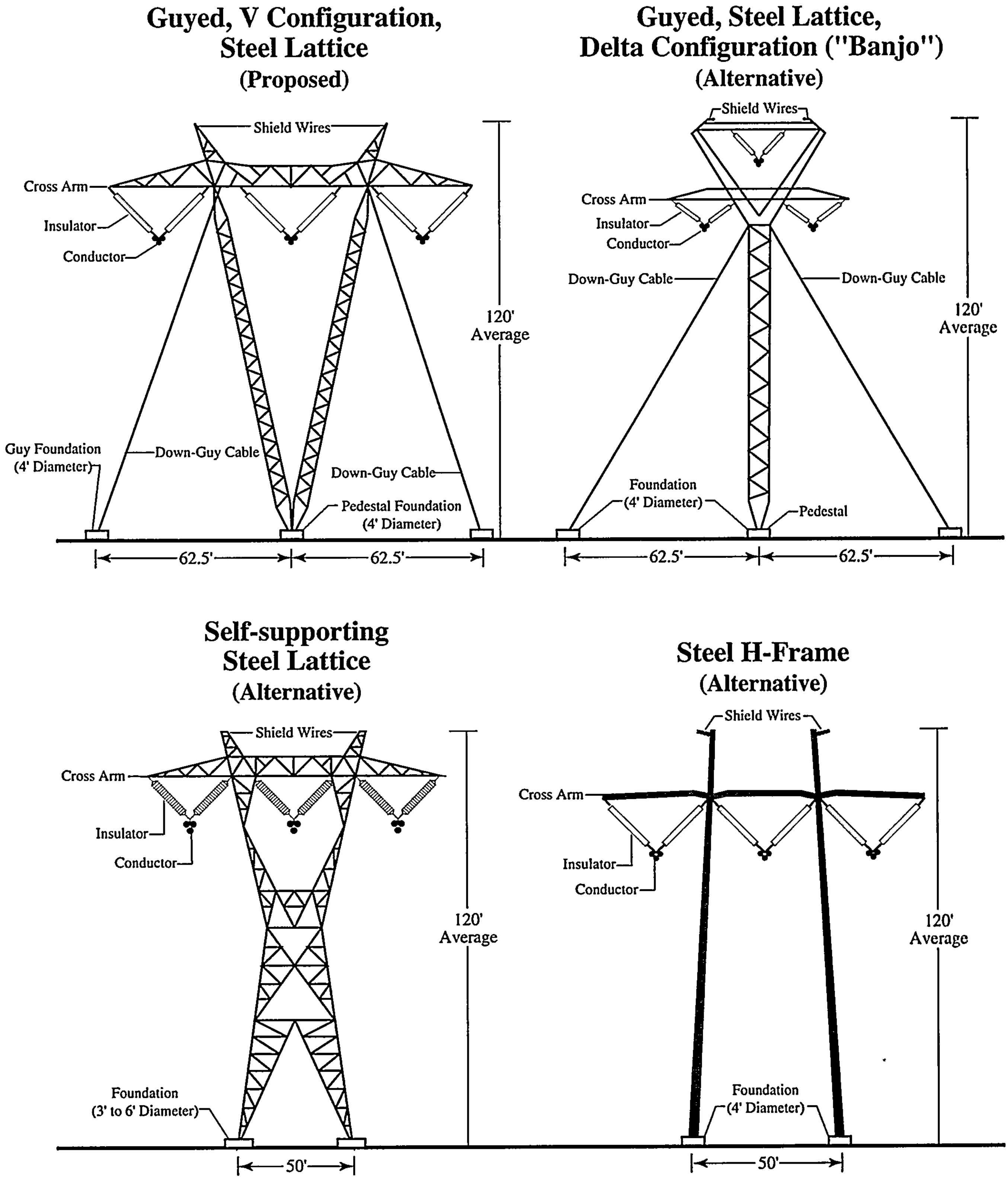
The components of the transmission line are described below.

Tower Structures

The proposed tower structure for NTP is a guyed, V-shaped, single-pedestal, steel-lattice structure fabricated from unpainted, galvanized steel (Figure 2-1 and Table 2-1). This type was selected because less steel is required for the structure and therefore it is less expensive. Alternative structure types would be used where warranted for engineering or economic reasons or to mitigate environmental impacts. Other potential structure types that could be used include (1) guyed delta structure; (2) four-legged, self-supporting structure; or (3) H-frame, tubular-steel structure. Regardless of the structure type used, the span between towers would range from 1,200 to 1,500 feet (4 or 5 towers per mile), with occasional exceptions as required. The height of the structures could range from 90 to 160 feet, but would average 120 to 130 feet. In addition, more robust dead-end structures would be used regardless of the tangent structure type used.

The area of the base of the structures would vary depending on structure type and terrain. However, all of the area surrounding the foundations and/or guy anchors would be usable for compatible and permitted uses, which are described in the operation, maintenance, and abandonment section of this chapter.

The following paragraphs describe the structure types in more detail.



Note: Dimensions are approximate and drawings are not to scale.

Typical 500kV Tangent Structure Types

Navajo Transmission Project

Figure 2-1

TABLE 2-1 DESIGN CHARACTERISTICS OF THE 500kV TRANSMISSION LINE	
Line Length	■ 386 to 508 miles (depending on route selected)
Type of Structure	■ guyed, "V-shaped" steel lattice (proposed) ■ guyed steel-lattice, delta configuration (alternative) ■ self-supporting steel lattice (alternative) ■ tubular-steel H-frame (alternative)
Structure Height	■ average 120 feet (range 90 to 160 feet)
Span Length	■ 1,200 to 1,500 feet average span
Number of Structures Per Mile	■ 4 to 5
Right-of-way Width	■ 250 feet
Land Temporarily Disturbed (per mile): (1) Tower base: ■ guyed steel lattice ■ tubular steel H-frame ■ self-supporting steel lattice (2) Wire-pulling sites (3) Wire-splicing sites (4) Material staging sites (5) Batch plants	 ■ 200 x 200 feet (0.9 acre) (3.5 to 4.5 acres per mile) ■ 200 x 200 feet (0.9 acre) (3.5 to 4.5 acres per mile) ■ 200 x 200 feet (0.9 acre) (3.5 to 4.5 acres per mile) ■ 200 x 200 feet (0.9 acre) per 3 miles ■ 20 x 50 feet (0.02 acre) per 3 miles ■ 400 x 540 feet (5 acres) per 40 miles ■ 2 acres per 30 miles
Land Required Permanently (per mile): (1) Tower base: ■ guyed steel lattice ■ self-supporting steel lattice ■ tubular-steel H-frame (2) Access roads (average acres per mile of transmission line) by ground disturbance level: ■ use existing roads (Access Level 1) ■ upgrade existing roads (Access Level 2) ■ construct new roads (Access Level 3) (Access Level 4) (Access Level 5) (Access Level 5)	 ■ five 4-foot-diameter foundations (.006 acre or 283 square feet) ■ four 6-foot-diameter foundations (.01 acre or 509 square feet) ■ two 4-foot-diameter foundations (.0026 acre or 113 square feet) ■ 0.3 acre ■ 0.3 acre ■ 1.5 acres ■ 1.7 acres ■ 2.3 acres ■ 3.1 acres
Voltage	■ 500,000 volts (v) AC
Capacity	■ 1,200 to 1,800 MW
Circuit Configuration	■ single circuit, two- to three-conductor bundle per phase with three phases, horizontal configuration
Conductor Size	■ 1272 to 1590 kcmil (1.345 to 1.504 inch diameter) ACSR (final selection under study)
Max. Anticipated Electric Field at Edge of ROW	■ 1.0kV/meter
Magnetic Field at Edge of Right-of-Way	■ less than 50 milli-Gauss (mG)
NESC Standard for Ground Clearance of Conductor	■ 29 feet minimum at 176 degrees Fahrenheit
Tower Foundations	■ drilled piers, cast-in-place concrete, pre-cast pads, or inserts

Guyed, "V"-Shaped Structure—The guyed, V-shaped steel-lattice structure with a horizontal cross arm at the top would have a single footing and four down-guy cables. Each cable would be about one inch in diameter. The foundation for the single footing would be 3 to 4 feet in diameter and 12 to 24 feet deep. Each guy anchor would be four feet in diameter and about six feet deep. The concrete foundations and guy anchors would be cast in place.

Guyed, "Delta" Structure—This guyed, steel-lattice structure would have a single footing and four down-guy cables, and the body of the tower would be a single pedestal with a delta- or triangle-shaped top. The foundation and guy anchors would be the same as that for the guyed, V-shaped structure.

Four-Legged, Self-Supporting Structure—In certain instances, the four-legged, self-supporting, unpainted galvanized steel lattice structure may be preferable. These structures could be used in areas of steep terrain where slopes are greater than the angle of the guy, or in situations where guy cables would extend beyond the edge of the right-of-way. In areas considered visually sensitive where the proposed line would parallel existing self-supporting structures, less visual contrast would be created if structures similar to the existing ones were used. Self-supporting structures also could be used to reduce potential construction and maintenance problems (e.g., where a narrower right-of-way would be needed due to terrain constraints). The concrete foundation of each leg would be 3 to 6 feet in diameter and 12 to 24 feet deep.

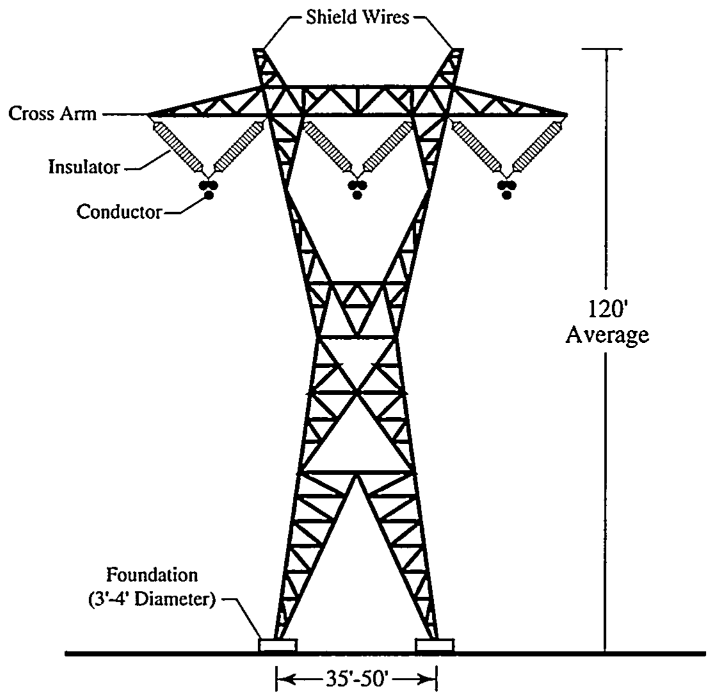
H-Frame, Tubular-Steel Structure—H-frame, self-supporting, tubular-corten steel (dark, rust-like finish) towers may be less intrusive in some areas and could be used instead of other tower types (particularly guyed structures) where they may interfere with other land use activities such as agricultural practices (e.g., machinery operations and gravity water flow irrigation systems). Also, in areas where an existing H-frame transmission line may be paralleled, an H-frame structure may be recommended as mitigation to reduce the visual contrast in the landscape. The concrete foundation of each leg would be about four feet in diameter and 12 to 24 feet deep.

Dead-End Structure—At certain locations along the transmission line, more robust tower structures would be needed (1) to add longitudinal strength to the line, (2) at turning points (angles), (3) for added safety at crossings of utilities such as transmission lines, and (4) to interrupt long distances (15 to 25 miles) of suspension structures that would otherwise provide more exposure to a catastrophic line failure. In most cases, the more robust structures would be self-supporting steel lattice. Alternatives to this would be self-supporting, three-pole, tubular-steel structures; tangent structures for straight portions of the line; or angle structures for turns in the line. Alternative dead-end structures are shown on Figure 2-2.

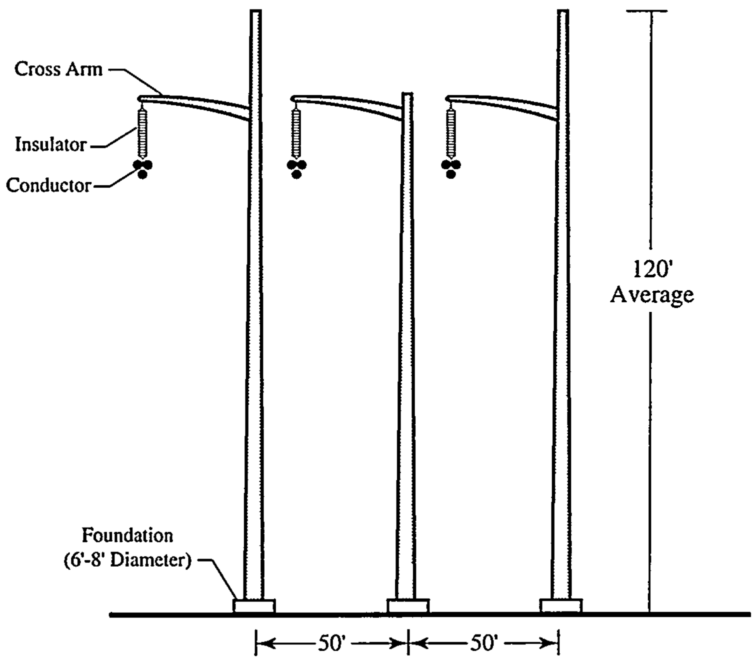
Conductor

The conductor, the wire cable strung between transmission line towers through which the electric current flows, would be aluminum conductors steel reinforced (ACSR). The aluminum carries most of the electrical current and the steel provides tensile strength to support the aluminum strands. The NTP transmission line would have three phases, each consisting of a bundle of two or three conductors. Spacing between each subconductor in a bundle would be about 18 inches, but the configuration of the

Self-supporting Steel-lattice
(used with steel-lattice tangent towers)



Self-supporting Tubular Steel
(used with H-Frame tangent towers)



Note: Dimensions are approximate and drawings are not to scale

Typical 500kV Dead-end Structure Types

Navajo Transmission Project

Figure 2-2

bundles would be determined at the engineering-design stage of the project. The conductor would be treated to make it less shiny and noticeable. This "nonspecular" type of conductor would be used for the entire length of the transmission line, thereby reducing the visual impact of the transmission line in the landscape.

The height of the conductors above the ground would be a minimum of 29 feet, based on the National Electric Safety Code (NESC) and Western's standards. The minimum conductor vertical clearance dictates the exact height of each tower structure, based on topography and requirements for safety. The minimum conductor vertical clearances in some instances may be greater in response to logistical requirements or more specific NESC requirements (e.g., minimum clearance above trees in forested areas).

Insulators and Associated Hardware

Insulators, which are made of an extremely low conducting material such as porcelain, glass, or polymer, are used to suspend the conductors from each tower. Insulators inhibit the flow of electrical current from the conductor to the ground or another conductor. A permanent assembly of insulators, ranging from 14 to 20 feet long, would be used to position and support each of the three conductor bundles to the tower. These assemblies are either V or I shaped. The assemblies of insulators are designed to maintain electrical clearances between the conductors, tower, and ground.

Overhead Ground Wires (Shield Wires)

To protect conductors from lightning strikes, two nonspecular overhead ground wires three-eighths to one-half-inch in diameter would be installed on top of the tower structures. Energy from lightning strikes would be transferred through the ground wires and structures into the ground. The ground wire could contain fiber optic cable to serve, in part, as a communication system for the project in addition to Western's existing microwave communication system. The appearance of the proposed ground wire/fiber optic cable would not be substantially different from a conventional ground wire without fiber optic cable.

Substations

Three substations would be constructed for the proposed NTP transmission line—one at each end of the transmission line and one at an intermediate location. The amount of land required for the substations would vary depending on the layout of associated electrical equipment (345kV or 500kV interconnection), and potential setbacks from relocation of existing utilities (e.g., electric transmission lines).

The proposed substation at the eastern end of the transmission line would be constructed at Western's existing Shiprock Substation near Shiprock, New Mexico. The additional equipment required most likely would be installed adjacent to the northwestern portion of the existing substation. Approximately 50 additional acres would be needed.

Two alternative locations are being considered for the substation at the western end of the transmission line in southeastern Nevada—either at Western's existing Mead Substation or at the jointly owned Marketplace Substation, both located near Boulder City, Nevada. Approximately six additional acres of space would be needed at the Mead Substation if the line were to terminate at that location and a small amount, if any, of additional acreage would be needed if the line were to terminate at the Marketplace Substation.

Five alternative sites in north-central Arizona are being considered for the intermediate substation:

- Honey Draw Substation site approximately 3 miles south of Page and 1.5 miles west of the community of Lechee

- Red Mesa Substation site near Red Mesa along Western's existing 345kV transmission line

- Copper Mine Substation site approximately 9 miles southwest of the community of Copper Mine along Western's existing 345kV transmission line

- a site near or adjacent to the existing Moenkopi Substation

- Red Lake Substation site approximately 15 miles north of Williams, Arizona

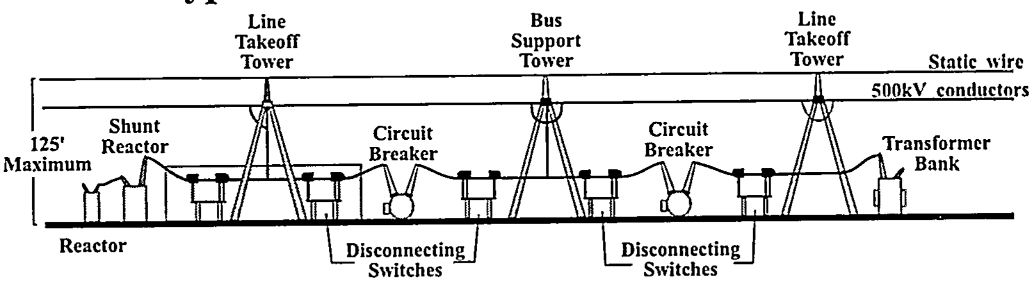
About 60 acres would be needed for the intermediate substation.

Preparation of sites for substation facilities would require the following:

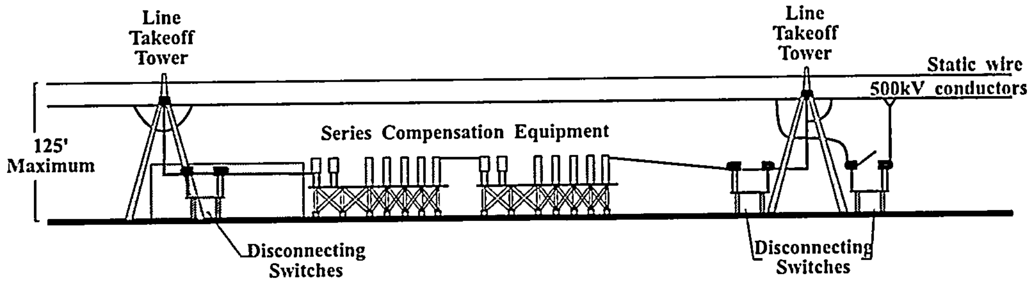
- cut-and-fill grading
- placement and compaction of structural fill to serve as a foundation for equipment
- grading to maintain drainage patterns
- oil spill containment facilities
- gravel-surfaced yard
- gravel-covered parking areas approximately 100 by 100 feet
- gravel-base roads approximately 20 feet wide
- fencing and gate
- revegetation with native plants, where practicable
- subsurface grounding grids

The appearance of a substation for NTP would be similar to the illustration in Figure 2-3. The maximum height of structures in the substation would be approximately 125 feet. The substation yards would be open air and would include transformers, circuit breakers, disconnect switches, lightning/surge arresters, reactors, capacitors, bus (conductor) structures, and a microwave antenna (Table 2-2). Also, series compensation equipment would be included within the NTP substations (see Figure 2-3).

Typical Section of a 500kV Substation

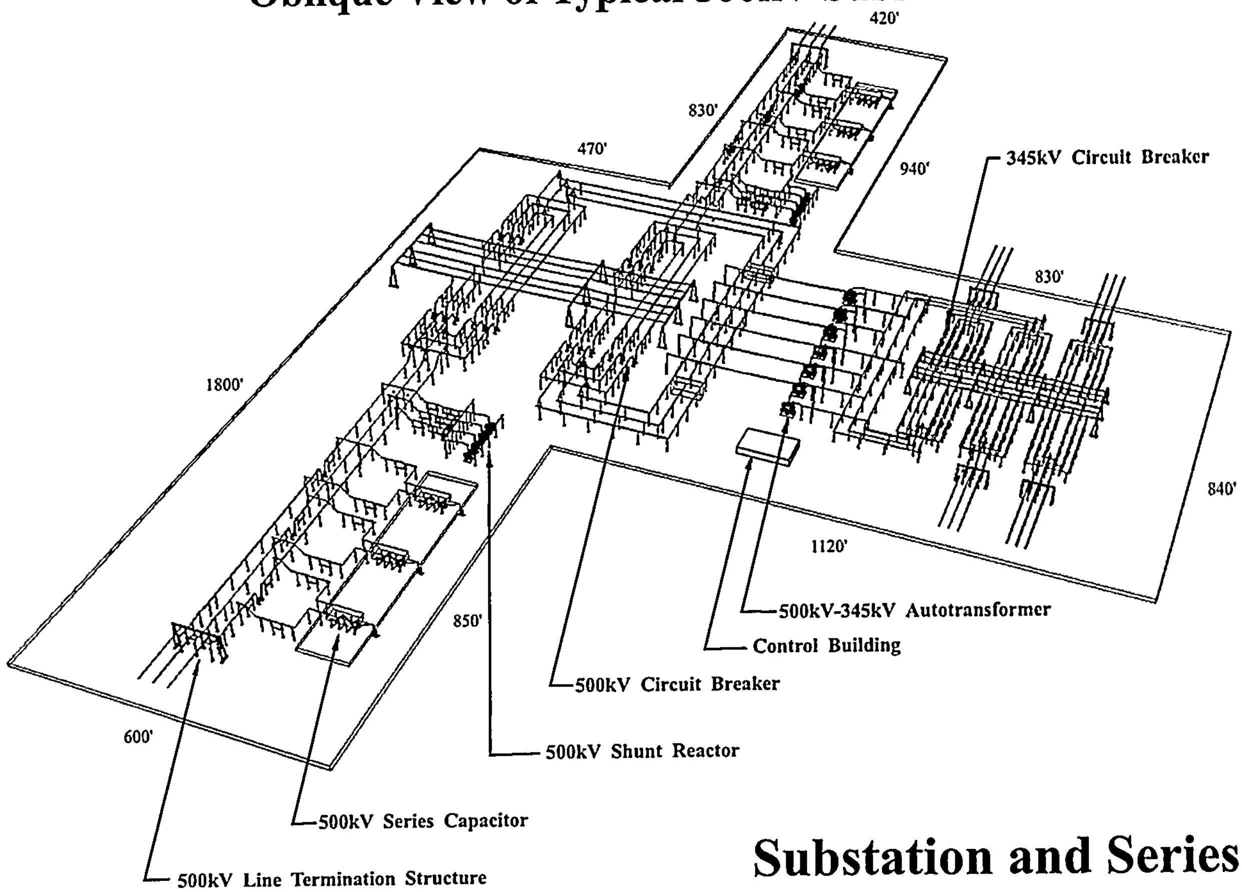


Typical Section of a Series Compensation Station



Note: 1) Illustration for graphics representation only, not approved for construction.
2) Series compensation equipment would be within the substation yard.

Oblique View of Typical 500kV Substation



Substation and Series Compensation Facilities

Navajo Transmission Project

Figure 2-3

Note: Dimensions are approximate and drawings are not to scale.

TABLE 2-2 DESIGN CHARACTERISTICS OF A SUBSTATION AND SERIES COMPENSATION STATION		
	Substations	**Series Compensation**
Site Size (approximate)	■ 50 to 60 acres	■ included in substation
Equipment	■ transmission line takeoff structures ■ power circuit breakers ■ power transformers ■ switches equipment ■ buswork or bus conductor ■ control house ■ microwave antenna ■ current limiting reactor	■ electrical towers ■ series capacitor banks ■ switching equipment ■ bus conductors
Access Road ■ width ■ road surface ■ grading	 ■ 20 feet ■ gravel ■ heavy road base to support larger equipment	 ■ same as substation
Power Required for Operation	■ 50 kilowatts	■ 50 kilowatts
Fire Protection Facilities	■ fire wall barriers for protection from transformers	
Building	■ 5,000 square feet	■ not required
Slopes/Drainages	■ 0.5 to 1.0 percent	■ 0.5 to 1.0 percent
Substation/Series Compensation Grounding	■ use copper wire for personnel safety and grounding	■ use copper wire for personnel safety and grounding
Land Temporarily Disturbed	■ site specific	■ site specific
Land Permanently Disturbed	■ site specific grading and drainage	■ site specific grading and drainage
Voltage	■ multiple voltages, can change voltage from 500kV to 230kV	■ 500kV single voltage
500kV Transmission Station Electrical Requirements and Ratings ■ Transfer Capacity—1,500 to 2,200 megavolt amperes ■ Operating Voltage Range—475 to 550kV, root mean squared ■ Bus Capacity @ 525kV, 1,650 Amps ■ Basic Insulation Levels - 1,500kV for bus support insulation 1,800kV for bushings and switch gaps ■ Phase-to-phase clearances (metal-to-metal) 20 to 28 feet ■ Phase-to-ground clearances (metal-to-metal) 10 to 12 feet ■ Phase-to-ground clearances (personal safety) 23 feet minimum ■ Phase-to-ground clearances (station roadways) 40 feet minimum		

The control building would be a structure approximately 50 feet wide, 100 feet long, and approximately 10 feet high, and it would be constructed of conventional building material.

The substations would be designed and constructed to prevent and control accidental spills from oil-filled equipment from affecting adjacent land uses and from reaching water bodies in the vicinity of the substation. The ground level of the substation yard would be graded to direct the flow of water runoff.

The yard would be covered with a layer of gravel (four or more inches thick) that would help inhibit flow of water or other liquids, and would serve as an absorbent in the event of an oil spill. Berms, or other barriers, would be used around the perimeter of the yard (along the fence line) to control runoff. Where needed, control areas such as retention ponds would be designed and constructed to contain runoff. Also, containment structures would be constructed at the base of oil-filled equipment. These structures, usually made of cement, would be designed to contain spills. If a large volume of oil were to leak from a piece of electrical equipment, an alarm or a failure would occur notifying the operations center of the problem, and a trained maintenance crew would be dispatched to the substation immediately to begin repairs and cleanup. Oil Spill Contingency (OSC) plans and/or SPCC plans would be developed for the new substation and updated for the expansion of existing substations. These plans explain cleanup and emergency notification procedures specific to each substation. Also, the substation facilities would be enclosed by chain-link fence with a locking gate and adequate night lighting for security.

Communication Facilities

For safe and efficient operation, the proposed transmission line would require reliable, secure communication circuits for protective and control relaying. Communication systems for NTP would employ microwave and/or fiber optics.

As mentioned previously, fiber optic cable may be imbedded in the overhead ground wire and would function, in part, as a communication system for the project in addition to Western's existing microwave communication system. The new fiber optic system could be used for voice communication, protective relaying telemetering, supervisory control and data acquisition, and potentially for other commercial communications purposes. The fiber optic communication system would require regeneration stations at 40- to 60-mile intervals to reamplify the signals across the system. The regeneration stations are typically housed in buildings, the bases of which are approximately 10 by 10 feet and the height is about 8 feet. The buildings contain optical regenerator equipment, 48-volt batteries, and battery chargers.

With one exception, Western's existing microwave communication system could be used for NTP regardless of the final route selected for the transmission line. If the Red Lake Substation alternative were to be selected and constructed, a new intermediate repeater would be needed between Western's existing microwave site at Elden Mountain and the Red Lake Substation. The facility would be placed at a developed communication site on the peak of Bill Williams Mountain, administered by the Coconino National Forest, south of the town of Williams. According to the Forest Service, there is not sufficient space to construct any additional communication facilities on the peak; however, Western could negotiate an agreement with an existing user to share their facility. The existing microwave facilities could require some modifications (e.g., new equipment); however, these modifications would not be expected to require much ground-disturbing activity. Often, only a new parabolic (bowl-shaped) dish (6 to 8 feet in diameter) would have to be added to the tower. Antenna heights are approximately 60 feet or less. Communications equipment at Red Lake Substation would be constructed within the substation yard. A typical microwave facility is shown on Figure 2-4.

No new communication buildings would be needed since there are existing buildings at Bill Williams Mountain and Elden Mountain, and since the substation control building would house the communication equipment at Red Lake Substation. The buildings at these facilities are locked and secured, with entry restricted to appropriate utility personnel. The microwave facilities are unmanned and operate automatically in response to incoming signals.

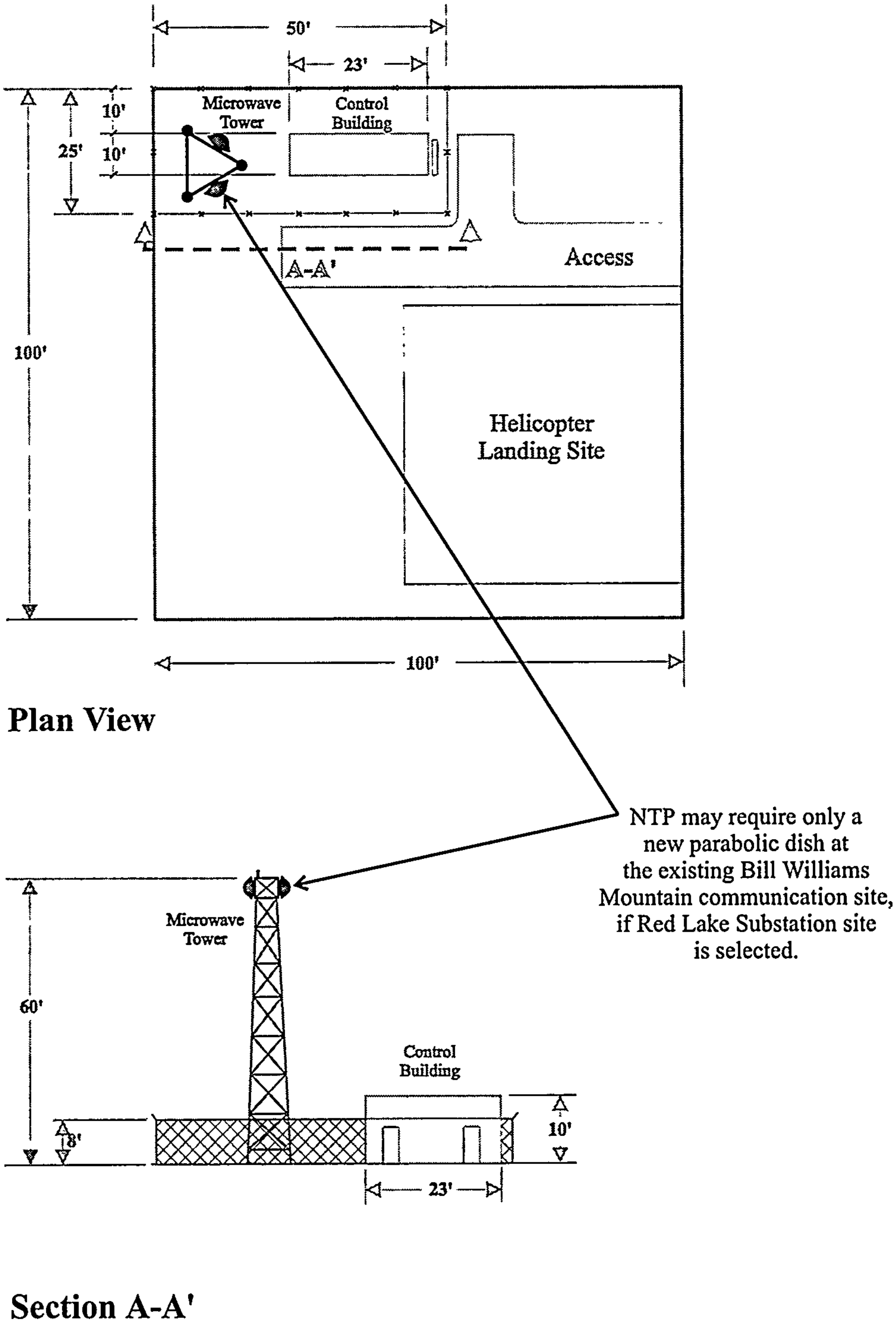
Right-of-Way Acquisition

New or additional land rights would be needed to accommodate NTP including the transmission lines, access roads, and substations. The transmission line right-of-way, the strip of land across which the transmission line passes, would require a width of 250 feet (Figure 2-5). Where the proposed transmission line would parallel an existing transmission line, the NTP right-of-way would be adjacent to or overlap the existing right-of-way. The right-of-way width must be sufficient to accommodate "conductor blowout" due to wind (which is the swinging of the conductor midway between tower structures), guy wires and anchors, and maintenance clearances at the tower sites. Additional right-of-way may be required in areas where the proposed transmission line would turn at a sharp angle and for installation of ground rods. Also, areas used temporarily (e.g., roads, staging areas, batch plants) may require temporary use permits.

In September 1992, the Resources Committee of the Navajo Nation Council granted a conditional right-of-way to accommodate the 250-foot-wide right-of-way required by NTP and additional right-of-way for a potential future transmission line (a total of 400 feet). The location of the conditional right-of-way is contingent on satisfactorily completing all permitting requirements. Currently, no firm plans or proposals for another transmission line have been identified. Until a clear need for another line arises, the size, type, and system requirements (path) cannot be known; therefore, only the impacts of the current proposed action (i.e., NTP) within a 250-foot right-of-way are addressed in this DEIS. (Refer to discussion of potential impacts associated with a second line in Chapter 4 cumulative effects section.)

Acquisition of Right-of-way Across American Indian Lands

Acquisition of rights-of-way across American Indian reservation lands is administered by numerous authorities, acts of Congress, and treaties. All American Indian reservation lands are held in trust by the Federal government. Any activities, dispositions, or uses, must be approved by the Secretary of the Department of the Interior through the BIA with contemporaneous consent of the tribal government. It is assumed that right-of-way on the Navajo Reservation and other American Indian reservation lands would be acquired by DPA and the Navajo Nation.

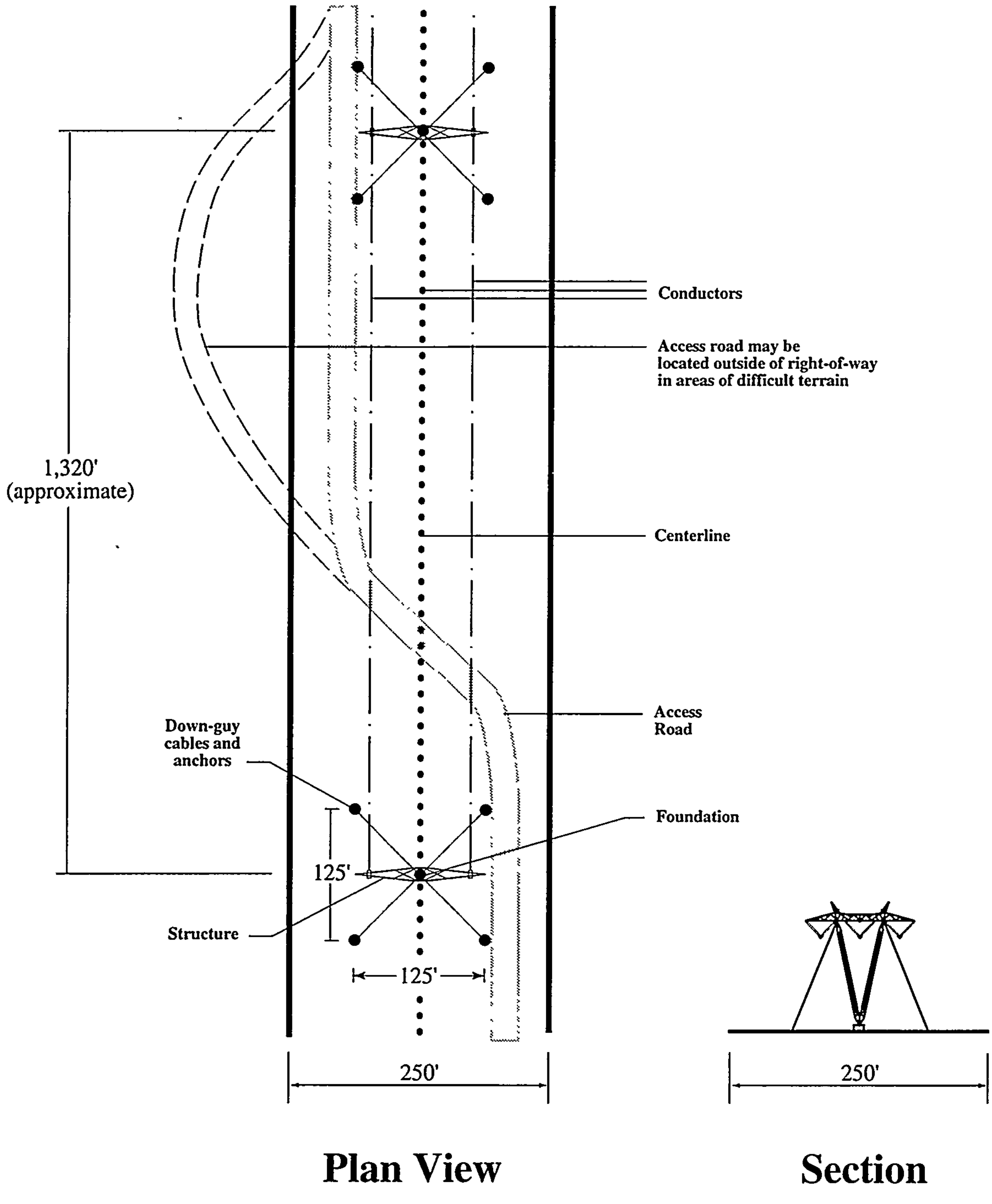


Note: Dimensions are approximate and drawings are not to scale.

Typical Microwave Facility

Navajo Transmission Project

Figure 2-4



Note: Dimensions are approximate and drawings are not to scale.

Right-of-way

Navajo Transmission Project

Figure 2-5

A right-of-way application would be made to the appropriate Real Property Management Branch, BIA agency office. The BIA Phoenix Area Office has jurisdiction over the Hopi (Hopi Agency) and Hualapai (Truxton Cañon Agency) tribes. The Navajo Area Office has jurisdiction over the Navajo Nation. The BIA then informs the tribe of the application. Concurrently, a right-of-way application would be made to the tribe, which processes the application. The application would be reviewed for accuracy, description, completion of the EIS, drawings, and local land users' consent.

Once the application is approved, it is reviewed for consideration by the tribal council, which acts on the application. Tribal approval of the right-of-way would be evidenced by a resolution approved by the respective tribe; whereas written consent of each landowner would be required on allotted lands. The application would be signed by the President or Chairman of the Nation or Tribe and then forwarded to the BIA for final approval. Upon satisfactory compliance with all requirements, the BIA Agency would prepare a grant of easement for right-of-way.

The applicant must first obtain permission to survey the centerline. The appropriate BIA Agency would furnish the applicant with names, addresses, and ownership interest in each trust allotment. The allottees then grant permission to survey. Separate consents are required for the allottees to grant right-of-way. The application includes a written agreement of compliance; maps of definite locations; appraisal report; and deposit of right-of-way consideration, allottees' written consent, archaeological clearance, and a copy of the EIS.

Acquisition of Right-of-way Across Federal Lands

The project proponents would need to obtain approval from each land-managing agency and reserve a grant for right-of-way (1) 250 feet wide for a specific number of miles across public lands; (2) for a specific period of time; (3) for the number of acres needed to construct a substation, if applicable; (4) for the amount of additional right-of-way acreage needed for access roads located outside of the 250-foot-wide right-of-way; and (5) for the estimated amount of acreage for an estimated number of any additional ancillary facilities that may cross or be constructed on public lands. In addition, temporary use permits would be required for temporary use areas such as material staging areas and concrete batch plants. Temporary use areas would have to be approved by the land-managing agency and the temporary use permits issued prior to construction.

For BLM, Western filed a preliminary right-of-way application early in the project (spring of 1994) to alert the BLM field offices regarding the proposed right-of-way, the type of use, and the Western point of contact. Once the Record of Decision has been issued, the application would be completed with project design details. A single right-of-way grant would be issued by the BLM Arizona State Office for all BLM lands crossed by the project.

The project proponents would seek the issuance of an agreement from NPS, a 50-year land use permit from the Forest Service, and a perpetual right-of-way reservation from BLM along with notices to proceed from each.

Acquisition of Right-of-way Across State Lands

Usually, land rights across state lands, such as in New Mexico and Nevada, would be acquired like private lands. However, the state of Arizona requires a public auction to dispose of real property interests.

Acquisition of Right-of-way Across Private Lands

All land rights would be acquired in accordance with Federal laws and regulations. Once a route for a transmission line has been selected, a list of all landowners with title to property lying within the transmission line right-of-way would be obtained from the county records. Permission to enter the property would be requested from the landowners for project personnel to conduct surveys, real property appraisals, environmental studies, and geological studies. From survey data of the transmission line and access road rights-of-way, detailed legal descriptions would be prepared and tract plats of the land rights to be acquired would be drawn. Every right-of-way would be individually appraised by a qualified real estate appraiser. The appraised value is tied directly to the value of the land and the impact of the facility on the land.

After the title evidence is obtained and the appraisal and legal descriptions are completed, realty specialists would present formal offers to acquire the necessary land rights. Land rights would be acquired in the form of an easement contract for transmission line rights-of-way and the land for substations would be acquired in fee simple. The realty specialist would explain the project and contract to the landowners. If agreeable to both the landowner and realty specialist, the contract would be signed. The executed contract would be recorded in the official records of the county and the right-of-way would be insured with title insurance. The landowner would be paid the amount of the contract's consideration. Also, all costs incidental to the contract's execution, such as recording fees, closing costs, and title insurance fees would be paid. After completion of construction, realty specialists would work with the landowners to settle any construction damages to the landowner's property.

If in negotiations between the project proponents and the landowner an agreement cannot be reached, or if clear title cannot be acquired, only then may Western be asked to use its authority to acquire land rights by "eminent domain" proceedings. Condemnation actions are handled by the local United States District Attorney, and condemnation cases are tried by the Federal District Court. Immediately upon filing a Declaration of Taking in the court, title to the land rights on the right-of-way would be vested in the name of the United States. Western would deposit in the court registry the just compensation amount determined by the appraisal. The court would determine the issue of just compensation at a subsequent date. During the trial, the landowner and the United States have the opportunity to present to the court evidence regarding just compensation.

Construction, Operation, and Maintenance Plan

Upon selection of a transmission line route, a plan for the development and implementation of the project would be prepared. Most of the Federal land-managing agencies require such a plan (e.g., a plan of development for BLM and a COMP for the Forest Service). At a meeting with the agencies early in the project, it was agreed that one document, a COMP, would be developed for the entire project to satisfy the requirements of the regulatory and land-managing agencies involved.

A COMP is a comprehensive document that completes a right-of-way application. A COMP addresses and incorporates requirements, policies, and principles of the applicable regulatory and land-managing agencies regarding the construction, operation, maintenance, and abandonment of the transmission line. The document provides detailed descriptions of work required at each tower site, ancillary facility location, and for each access road following selection of the final route and the final design. Agency stipulations and resource protection plans provide detailed guidelines for resource protection and site rehabilitation during and after construction (e.g., mitigation). Also, a COMP provides information about responsible project and agency authorities, emergency response plans, health and safety requirements, etc.

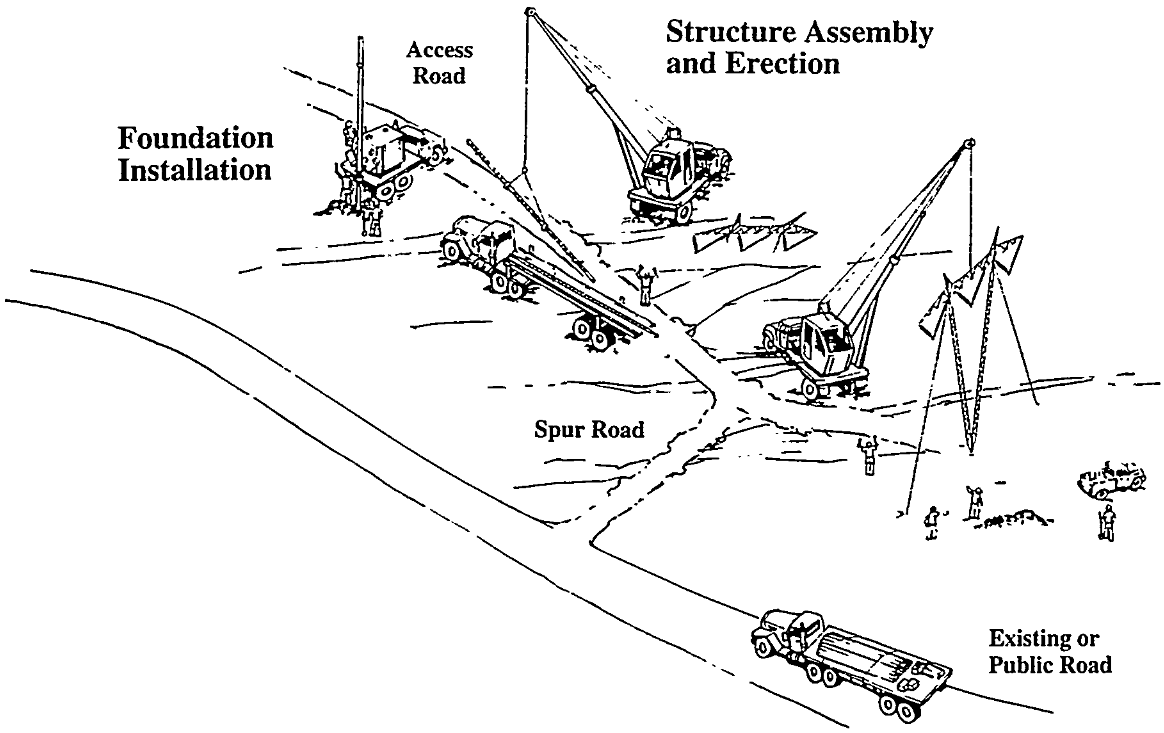
Construction

Preconstruction conferences with each of the affected agencies would be conducted to introduce the contractors and their field representatives, discuss mitigation measures and schedules, and introduce each agency's point of contact prior to commencement of construction. As construction proceeds, the construction engineer or inspector would continue to monitor activities and right-of-way authorizations to ensure compliance or to initiate modifications, where necessary. In environmentally sensitive areas, an environmental specialist with appropriate qualifications (e.g., biologist, archaeologist) would monitor construction activities to ensure compliance with specific resource mitigation. Following completion of the construction, the line would be mapped as built and separate packages would be submitted to each of the various agencies to close the acquisition process. Post-construction meetings with each of the agencies may be necessary to review the acquisition process and to determine if modifications are needed.

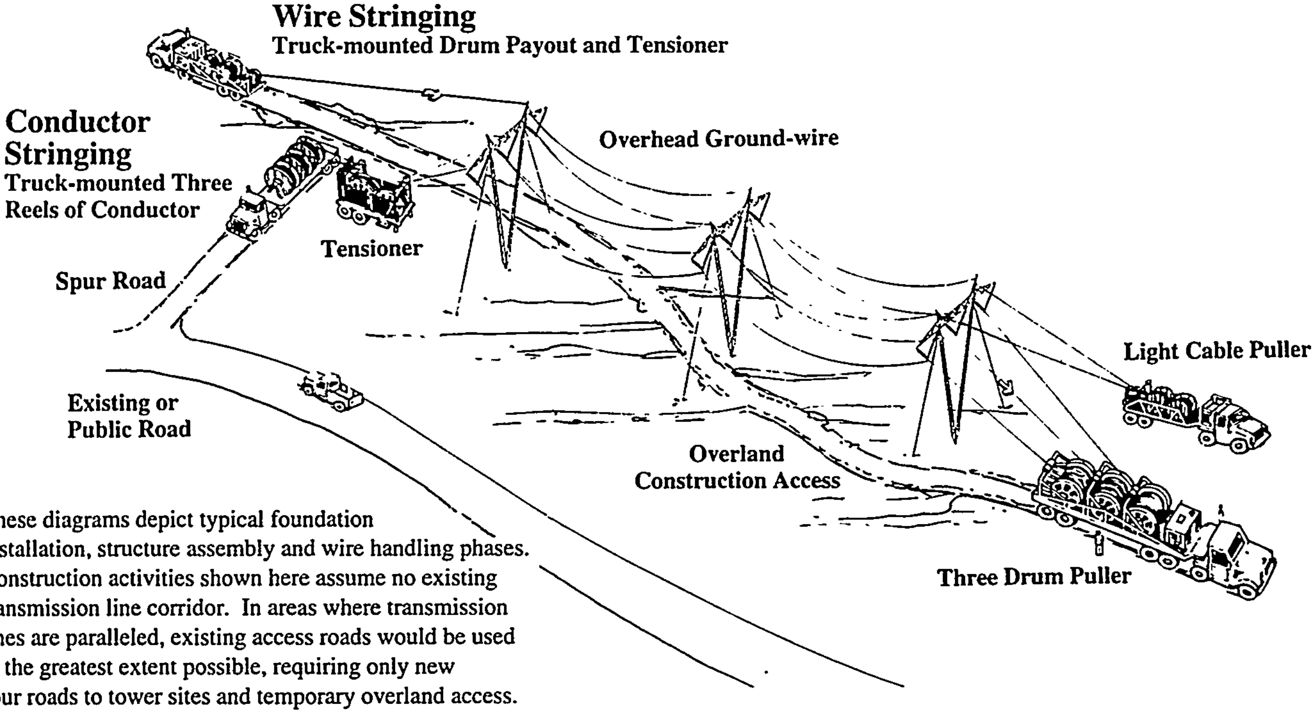
Construction of a transmission line is discussed in the following section according to the sequence of activities as listed below (Figure 2-6):

- surveying the transmission line centerline
- identifying/upgrading or constructing temporary and long-term access roads
- clearing activities for right-of-way, tower sites, construction yards, batch plants
- excavating and installing foundations
- assembling and erecting towers with temporary and permanent pad sites
- clearing of pulling, tensioning, and splicing sites
- stringing conductors and ground wires
- installing counterpoise (tower grounds) where needed
- cleaning up and reclaiming affected land areas

Foundation and Structure Construction Activities



Conductor and Ground-wire Stringing Activities



These diagrams depict typical foundation installation, structure assembly and wire handling phases. Construction activities shown here assume no existing transmission line corridor. In areas where transmission lines are paralleled, existing access roads would be used to the greatest extent possible, requiring only new spur roads to tower sites and temporary overland access.

Typical Construction Activities
Navajo Transmission Project

Figure 2-6

The proponents, DPA and Western, commit to undertake certain measures to protect the environment as standard practice for the entire project. These measures are referred to in this document as "generic mitigation," and are summarized in Table 2-3.

Surveying the Centerline—The survey would involve verifying the centerline of the route, tower center hubs, down-guy anchor hubs, right-of-way boundaries, access roads (where needed), and spur roads to tower sites. Some of these activities could begin as much as two years before the start of construction. Project proponents may decide to begin cultural and biological resources intensive surveys once certain points along the centerline are established.

Access Roads—Roads enable access to the right-of-way and tower sites for both construction and long-term maintenance of the transmission line. Access roads must be sufficient to bear the weight and endure heavy construction vehicle use. All roads would be upgraded or constructed in accordance with standard construction practices, or according to the land-managing agency's requirements. However, existing paved and unpaved highways and roads would be used, where possible, for the transportation of materials and equipment from the storage yards to the areas where they would be needed along the transmission line right-of-way.

Private landowners or land users would be consulted before road construction begins. Specific plans for construction, rehabilitation, and/or maintenance of roads would be documented in the COMP during the engineering-design phase of the project. These plans would incorporate the relevant criteria of the affected agencies and landowners or land users.

Where the proposed transmission line would parallel existing transmission lines or other linear utilities, the access roads along the existing utilities would be used where possible to minimize the amount of new road construction. However, these roads could require upgrading before they could be used for construction. All roads existing prior to construction of NTP would be left in a condition equal to or better than their condition prior to construction. Where existing roads could be used, only spur roads to the tower sites may be needed. Also, many areas may not require road access, but rather could be accessed by simply driving overland.

In some areas, only temporary roads would be needed. Typically, these temporary roads would be graded to a travel-surface width of about 12 feet. Turnout areas and curves would require a wider surface. Normally a ditch drainage system would not be constructed for temporary roads.

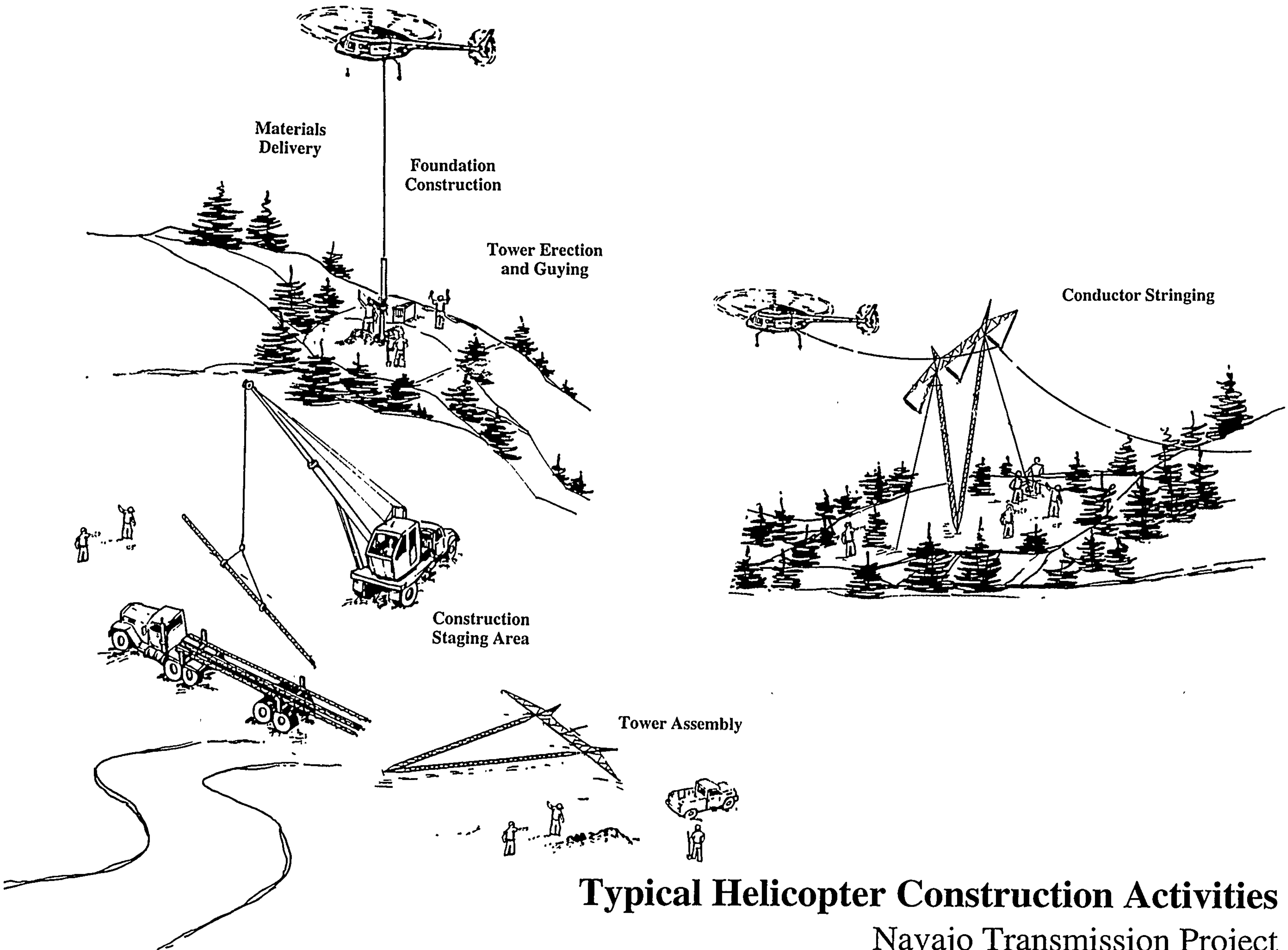
Helicopters may be used for construction (tower placement) in areas where there are environmental constraints, access is difficult due to terrain, or it is economically practical (Figure 2-7).

Permanent access roads would be constructed where needed for construction and long-term maintenance, or where the landowners or land-managing agencies require. Permanent roads also would be graded to a travel-surface width of about 12 feet except where turnout areas and curves or specifications of the land-managing agency require a wider surface. The roads would usually follow the natural grade; the maximum slope would be 15 percent. Typically, ditches on either side of the road would serve as drainage.

TABLE 2-3
GENERIC MITIGATION

1.	All construction vehicle movement outside the right-of-way normally will be restricted to predesignated access, contractor-acquired access, or public roads.
2.	The areal limits of construction activities normally will be predetermined, with activity restricted to and confined within those limits. No paint or permanent discoloring agents will be applied to rocks or vegetation to indicate limits of survey or construction activity.
3.	In construction areas where recontouring is not required, vegetation will be left in place wherever possible and original contour will be maintained to avoid excessive root damage and allow for resprouting.
4.	In construction areas (e.g., marshalling yards, tower sites, spur roads from existing access roads) where ground disturbance is substantial or where recontouring is required, surface restoration will occur as required by the landowner or land-management agency. The method of restoration normally will consist of returning disturbed areas back to their natural contour, reseeding (if required), installing cross drains for erosion control, placing water bars in the road, and filling ditches. To avoid fragmentation of pronghorn habitat, fencing will not be used as a means of closing roads or otherwise limiting access. These instances will be reviewed on a case-by-case basis.
5.	Watering facilities and other range improvements will be repaired or replaced if they are damaged or destroyed by construction activities to their condition prior to disturbance as agreed to by the parties involved.
6.	Towers and/or ground wire will be marked with highly visible devices where required by governmental agencies (e.g., Federal Aviation Administration).
7.	On agricultural land, right-of-way will be aligned, to the extent practicable, to reduce the impact on farm operations and agricultural production.
8.	Prior to construction, all supervisory construction personnel will be instructed on the protection of cultural, paleontological, and ecological resources. To assist in this effort, the construction contract will address: (a) Federal, state, and tribal laws regarding antiquities, fossils, plants and wildlife, including collection and removal; and (b) the importance of these resources and the purpose and necessity of protecting them.
9.	Cultural resources will continue to be considered during post-EIS phases of project implementation in accordance with the programmatic agreement that is being developed in conjunction with preparation of the EIS. This will involve intensive surveys to inventory and evaluate cultural resources within the selected corridor and any appurtenant impact zones beyond the corridor, such as access roads and construction equipment yards. In consultation with appropriate land-managing agencies and State Historic Preservation Officers, specific mitigation measures will be developed and implemented to mitigate any identified adverse impacts. These may include project modifications to avoid adverse impacts, monitoring of construction activities, and data recovery studies. American Indian groups will be involved in these consultations to determine whether there are effective or practical ways of addressing impacts on traditional cultural places.
10.	The project sponsors will respond to individual complaints of radio or television interference generated by the transmission line by investigating the complaints and implementing appropriate mitigation measures (e.g., adjusting or using filtering devices on antennae). The transmission line will be patrolled on a regular basis so that damaged insulators or other transmission line materials, which could cause interference, are repaired or replaced.
11.	The project sponsors will apply mitigation needed to eliminate problems of induced currents and voltages onto conductive objects sharing a right-of-way to the mutual satisfaction of the parties involved.
12.	The project sponsors will continue to monitor studies performed to determine the effects of audible noise and electrostatic and electric and magnetic fields in order to ascertain whether these effects are significant.

TABLE 2-3 GENERIC MITIGATION	
13.	Roads will be built at right angles to the streams and washes to the extent practicable. Culverts will be installed where needed. All construction and maintenance activities will be conducted in a manner that will minimize disturbance to vegetation, drainage channels, and intermittent or perennial streambanks. In addition, road construction will include dust-control measures during construction in sensitive areas. All existing roads will be left in a condition equal to or better than their condition prior to the construction of the transmission line.
14.	All requirements of those entities having jurisdiction over air quality matters will be adhered to and any permits needed for construction activities will be obtained. Open burning of construction trash will not be allowed unless permitted by appropriate authorities.
15.	Fences and gates will be repaired or replaced to their original condition prior to project disturbance as required by the landowner or the land-management agency if they are damaged or destroyed by construction activities. Temporary gates will be installed only with the permission of the landowner or the land-managing agency.
16.	Transmission line materials will be designed and tested to minimize corona. A bundle configuration (three conductors per phase) and larger diameter conductors will be used to limit the audible noise, radio interference, and television interference due to corona. Tension will be maintained on all insulator assemblies to assure positive contact between insulators, thereby avoiding sparking. Caution will be exercised during construction to avoid scratching or nicking the conductor surface, which may provide points for corona to occur.
17.	Nonspecular conductors and ground wires will be used to reduce visual impacts.
18.	No nonbiodegradable debris will be deposited in the right-of-way. Slash and other biodegradable debris will be left in place or disposed of in accordance with requirements of the land-managing agency.
19.	The primary focus of paleontological mitigation efforts should be areas of greatest disturbance and areas likely to have significant fossils. Preconstruction surveys of such areas may be conducted as agreed upon by the land-managing agency and lead Federal agency.
20.	Mitigation measures developed during the consultation period under Section 7 of the Endangered Species Act (1974) will be adhered to as specified in the Biological Opinion of the U.S. Department of the Interior Fish and Wildlife Service. Also, mitigation developed in conjunction with state and tribal authorities will be adhered to.
21.	Hazardous materials will not be drained onto the ground or into streams or drainage areas. Totally enclosed containment will be provided for all trash. All construction waste including trash and litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials will be removed to a disposal facility authorized to accept such materials.
22.	At residences, the right-of-way will be aligned, to the extent practicable, to reduce impact on the residences and inhabitants.
23.	Special status species or other species of particular concern will continue to be considered during post-EIS phases of project implementation in accordance with management policies set forth by the appropriate land-managing agency. This may entail conducting surveys for plant and wildlife species of concern along the proposed transmission line route and associated facilities (i.e., access and spur roads, staging areas) as agreed upon by the land-managing agency and lead Federal agency. In cases where such species are identified, appropriate action will be taken to avoid adverse impacts on the species and its habitat and may include altering the placement of roads or towers as practicable and monitoring construction activities.



Typical Helicopter Construction Activities

Navajo Transmission Project

Figure 2-7

In certain areas, it could be necessary to block roads after construction to restrict future access for general and undesired use. Such areas would be identified in coordination with the landowner or land-managing agency. However, blocked access routes would have to be reopened when necessary where right of access is being impeded.

For the NTP EIS studies, the amount of ground disturbance from upgrading or constructing access was estimated. Six levels of ground disturbance were defined as summarized in Table 2-4. An aerial reconnaissance of all of the alternative routes was conducted to identify potential needs for access. Existing roads suitable for access and the general condition of each were mapped. This information was combined with slope data to provide an estimate of the potential ground disturbance that could result from upgrading existing roads or constructing new roads. These results were used as part of the impact assessment.

TABLE 2-4
GROUND DISTURBANCE/ACCESS LEVELS

Level 1	***Improved Roads*** Roads generally in good condition, but may need to be improved selectively. An average of 200 to 300 feet of spur road would be required to access each tower site. Spur roads would disturb about 0.3 acre per mile of transmission line.
Level 2	***Roads that Require Improvement*** Two-track and other unimproved roads that would require substantial improvement prior to construction. An average of 200 to 300 feet of spur roads would be required for each tower site. Spur roads would disturb about 0.3 acre per mile of transmission line.
Level 3	***Construct Road in Flat Terrain (0 to 5 percent)*** Approximately 1.0 to 1.1 miles of new road would be required for each mile of transmission line. Road construction would disturb approximately 1.5 acres per mile of transmission line.
Level 4	***Construct Road in Sloping Terrain (5 to 10 percent)*** Approximately 1.1 to 1.3 miles of new road would be required for each mile of transmission line. Road construction would disturb approximately 1.7 acres per mile of transmission line.
Level 5	***Construct Road in Steep Terrain (10 to 35 percent)*** Approximately 1.3 to 1.8 miles of new road would be required for each mile of transmission line. Road construction would disturb approximately 2.3 acres per mile of transmission line.
Level 6	***Construct Road in Very Steep Terrain (over 35 percent)*** Approximately 1.8 to 2.5 miles of new road would be required for each mile of transmission line. Road construction would disturb approximately 3.1 acres per mile of transmission line.

Clearing—Clearing of natural vegetation would be required for construction purposes (access and tower sites), land surveying activities, clearances for electrical safety, long-term maintenance, and reliability of the transmission line.

Within or adjacent to the right-of-way, mature vegetation would be removed under or near the conductors to provide adequate electrical clearance as required by NESC and DOE order WAPA 6460.1. Trees that could fall onto the transmission line, affect the transmission line during wind-induced conductor swing, or otherwise present an immediate hazard to the transmission line or have the potential to encroach within the safe distance to the conductor as a result of bending, growing, swinging, or falling toward the conductor would be removed. The normal procedure is to top or remove only large trees. If a conflict were to arise regarding clearance procedures, the conflict would be reviewed and agreed on by the project proponents and land managers or owners.

At each tower site, leveled areas, or pads (approximately 30 by 40 feet), would be needed to facilitate the safe operation of construction equipment, such as cranes. At each tower site, a work area of approximately 200 by 200 feet would be required for the location of tower footings, assembly of the tower, and necessary crane maneuvers. The work area would be cleared of vegetation only to the extent needed. After construction, all pads not needed for normal maintenance of the transmission line would be graded to blend as near as possible with the natural contours, and revegetated with indigenous plant species. Areas would be reseeded prior to the season(s) when precipitation is normally received. For example, BLM Farmington District would require reseeding prior to the rainy season, which is July through September.

Temporary material staging sites would be located near each end of the transmission line and approximately every 40 miles along the route. These would be located in previously disturbed areas or in areas of minimal vegetative cover where possible and would require about five acres of land. The location of all sites would be determined through discussions with landowners or the land-managing agency.

Concrete used to construct foundations would be dispensed from a portable concrete batch plant. Approximately two acres of land would be required for each site. A rubber-tired flatbed truck and tractor would be used to relocate each plant along the right-of-way at 30-mile intervals. Where economically feasible, commercial ready-mix concrete could be used.

The construction yards and batch plants also would serve as field offices, reporting locations for workers, parking space for vehicles and equipment, sites for material storage, and stations for equipment maintenance. Facilities would be fenced and gates locked. Security guards would be assigned where needed.

Installing Foundations—Vertical excavations for foundations would be made with power drilling equipment. Where soils permit, a vehicle-mounted power auger or backhoe would be used. In rocky areas, the foundation holes would be excavated by drilling, blasting, or installing special rock anchors. All safeguards associated with using explosives (e.g., blasting mats) would be employed. Blasting activities would be coordinated with the appropriate land-managing agency, particularly for purposes of safety and protection of sensitive areas (e.g., springs, cultural resources). In extremely sandy areas, water or a gelling agent could be used to stabilize the soil before excavation.

Concrete footings would be cast in place following excavation. Steel grillage foundations would be specified in mountainous areas. Cast-in-place footings would be installed by placing reinforcing steel and a tower stub into the foundation hole, positioning the stub, and encasing it in concrete. Spoil material (excavated soil) would be used for fill where suitable and the remainder would be spread at the tower site.

The foundation excavation and installation would require access to the site by a power auger or drill, crane, material trucks, and ready-mix concrete trucks.

Assembling and Erecting Towers—Bundles of steel members and associated hardware would be shipped to each tower site by truck. Steel members would be assembled into subsections of convenient size and weight. The assembled subsections would be hoisted into place by a large crane and then fastened together to form a complete tower.

Stringing Conductors and Ground Wires—Insulators, hardware, and stringing sheaves would be delivered to each tower site. The towers would be rigged with insulator strings and stringing sheaves at each ground wire and conductor position.

For protection of the public during wire installation, guard structures would be erected over highways, railroads, power lines, structures, and other barriers. Guard structures would consist of H-frame wood poles placed on either side of barriers. These structures would prevent ground wires, conductors, or equipment from falling across obstacles. Equipment for erecting guard structures would include augers, line trucks, pole trailers, and cranes. Guard structures might not be required for small roads. In such cases other safety measures such as barriers, flagmen, or other traffic control would be used. Following stringing and tensioning of all conductors, the guard structures would be removed.

Pilot lines would be pulled (strung) from tower to tower by a helicopter and threaded through the stringing sheaves at each tower. Following pilot lines, a larger diameter, stronger line would be attached to conductors to pull them onto towers. This process would be repeated until the ground wire or conductor is pulled through all sheaves.

Ground wire and conductors would be strung using powered pulling equipment at one end and powered braking or tensioning equipment at the other end of a conductor segment as shown in Figure 2-6. Sites for tensioning equipment and pulling equipment would be approximately three miles apart. The tensioning site would be an area approximately 200 by 200 feet. Tensioners, line trucks, wire trailers, and tractors needed for stringing and anchoring the ground wire or conductor would be located at this site. The tensioner, in concert with the puller, would maintain tension on the ground wire or conductor while they were fastened to the towers. The pulling site would require approximately half the area of the tension site. A puller, line trucks, and tractors needed for pulling and temporarily anchoring the counterpoise, ground wire, and conductors would be located at this site.

Installing Ground Rods—Part of standard construction practices prior to conductor installation would involve measuring the resistance of the ground to electrical current near the tower structures. If the resistance were greater than 10 ohms, counterpoise (grounds) would be installed to lower the resistance to less than 10 ohms. Counterpoise would consist of a bare copper clad or galvanized steel cable buried a minimum of 12 inches deep, extending horizontally away from one or more tower legs for approximately 200 feet. If the counterpoise were to extend outside of the 250-foot right-of-way (which is anticipated to be infrequent), additional right-of-way to accommodate the counterpoise would be acquired.

Cleanup—Construction sites, material storage yards, and access roads would be kept in an orderly condition throughout the construction period. Refuse and trash would be removed from the sites and disposed of in an approved manner (e.g., in an approved landfill). In remote areas, trash and refuse could be removed to a construction staging area and contained temporarily until such time as it could be hauled to an approved site. No open burning of construction trash would occur without the appropriate landowners or land-managing agency approval.

Reclamation of Affected Areas—The right-of-way would be restored as near to its original condition as practicable. All practical means would be made to restore the land to its original contour and to restore natural drainage patterns along the right-of-way. Because revegetation would be difficult in many areas of the project where precipitation is normally minimal, every effort would be made to minimize disturbance during construction. All practical means would be made to increase the chances of vegetation re-establishment in disturbed areas (e.g., use of native plants, or seed mix specified by land-managing agency).

Construction Work Force and Schedule

It is anticipated that total construction time for the transmission line would be two and one-half years. Substation additions or new substations would be constructed concurrently. To facilitate management of construction, the transmission line could be constructed in segments. For example, construction of the line could be divided in four equal segments and awarded as four separate contracts; each could be awarded for a performance time of one year successively every six months. The total work force required to complete construction would be approximately 225 people. Equipment size would range from light to heavy duty. Table 2-5 lists the personnel and equipment needed for construction of the transmission line, substation, and communication facility. Figure 2-8 illustrates work force requirements during construction.

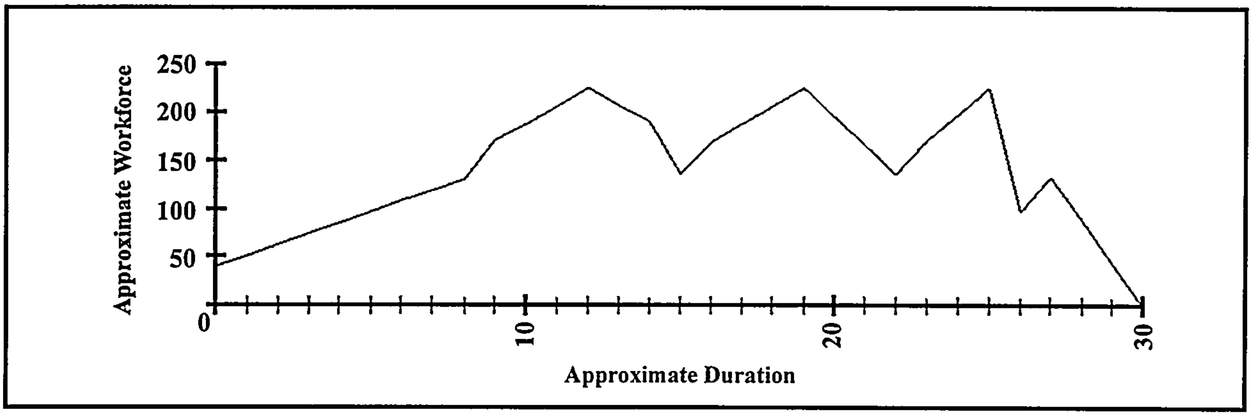


FIGURE 2-8
CONSTRUCTION WORK FORCE SCHEDULING

TABLE 2-5 CONSTRUCTION WORK FORCE AND EQUIPMENT		
Transmission Line		
Access Road Construction		
■ work force	12 people (including maintenance)	
■ equipment	2 bulldozers (D-6 or D-8) 2 motor graders 2 pickup trucks 2 water trucks (for construction and maintenance)	
Footing Installation		
■ work force	32 people	
■ equipment	2 hole diggers 1 bulldozer (D-6) 1 truck (2 ton) 6 concrete trucks 6 hydro crane (15 ton)	2 pickup trucks 2 carry alls 1 batch plant 2 dump trucks 2 wagon drills
Structure Steel Haul		
■ work force	12 people	
■ equipment	6 steel haul trucks 1 yard crane (heavy duty)	2 pickup trucks
Structure Assembly		
■ work force	32 people	
■ equipment	4 carry alls 4 pickup trucks	4 cranes (rubber tired) 4 trucks (2 ton)
Survey		
■ work force	6 people	
■ equipment	1 helicopter	2 pickups
Structure Erection		
■ work force	12 people	
■ equipment	2 cranes (60 ton) 2 trucks (2 ton)	2 pickup trucks

TABLE 2-5 CONSTRUCTION WORK FORCE AND EQUIPMENT	
Transmission Line	
Conductoring ■ work force ■ equipment	 48 people 1 helicopter and fly ropes 3 drum pullers (1 light, 1 medium, 1 heavy) 2 splicing trucks 2 double-wheeled tensioners (1 light, 1 heavy) 6 wire reel trailers 2 diesel tractors 1 crane (2 to 4 ton) 1 sagging equipment 4 trucks (5 ton) 6 pickup trucks
Clean-up ■ work force ■ equipment	 15 people 2 pickup trucks 2 trucks (2 ton)
Road Rehabilitation ■ work force ■ equipment	 6 people 1 bulldozer (D-8) 1 pickup truck 2 motor graders
Total Personnel Required = 175	
Substation and Communication Facility	
Work Force	50 people
Equipment	1 yard crane 1 bulldozer 1 road grader 2 pick-up trucks 1 water truck 1 concrete truck 1 dump truck

It is estimated that up to about 50 percent of this work force could be hired locally (including American Indians). This percentage is dependent on skills and manpower requirements. It is anticipated that hiring of construction workers would comply with the Tribal Employment Rights Ordinance and other tribal preference employment acts, as appropriate. Non local people would be expected to utilize temporary housing in nearby communities and commute to and from the job site on a daily basis. Some may own mobile homes and park them where connection facilities are available (special use permits may be required on American Indian reservations). Others would occupy rental houses and apartments.

Construction activities would be anticipated to commence in late 1998. Typical time frames to construct the proposed transmission line would be anticipated to be as follows:

- tower pad construction — 5 towers per day (1 mile per day)
- tower erection — 2 towers per day (by crane)
- conductor stringing — 1 mile per day (triple conductor)
- restoration — 5 miles per day

Typically, transmission line construction is staged such that all elements are completed at approximately the same time. Surveying and staking of structure sites can be expected to be an ongoing process for the life of each individual 52-week contract. Placement of concrete tower foundations would commence immediately and continue for 50 weeks on any 100-mile portion of the line. After 16 weeks, steel hauling and tower erection would commence and continue for 36 weeks. Cleanup, building fences and gates, and installing culverts and cattle guards are continuing operations over the length of the transmission line. Construction of a new substation or major addition can be accomplished in 50 to 80 weeks and is accomplished concurrently with transmission line construction. The target year for commercial operation of the project would be 2001.

There is the potential that the transmission line could be constructed in phases; for example, the eastern portion of the project area would be built, then the western portion could be built a number of months or even years later. Reasons for phasing construction of the overall project could include the following: response to changing market for transmission capacity, conditions and status of financing, socioeconomic objectives, and/or jurisdictional constraints (e.g., Bennett Freeze).

Health and Safety

Fire Protection—All applicable fire laws and regulations would be observed during construction. All Federal and contractor employees would be advised of their responsibilities under the applicable fire laws and regulations, including training and taking practical measures to prevent, suppress, and report fires.

Hazardous Materials—Petroleum products such as gasoline, diesel fuel, helicopter fuel, crankcase oil, lubricants, and cleaning solvents would be present on site during construction. These products would be used to fuel, lubricate, and clean vehicles and equipment. These products would be contained within fuel trucks or in approved containers. When not in use, such materials would be stored properly to prevent drainage or accidents.

All construction, operation, and maintenance activities would comply with all applicable Federal, state, tribal, and local regulations regarding the use of hazardous substances. Hazardous materials would not be drained onto the ground or into streams or drainage areas. Totally enclosed containment would be provided for all trash. All construction waste including trash and litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials would be removed and transported to a disposal facility authorized to accept such materials.

The construction or maintenance supervisor would ensure that all applicable Federal, state, tribal, and local laws are obeyed. These would include, but not be limited to, the Resource Conservation and Recovery Act; Comprehensive, Environmental Response, Compensation, and Liability Act; Toxic Substance Control Act; Department of Transportation regulations; Clean Air Act; Clean Water Act; and Emergency Planning and Community Right-to-Know. In addition, regulations of the Occupational Safety and Health Administration would be followed. A health and safety plan addressing procedures to respond to accidental release of hazardous materials would be developed as part of the COMP during the engineering-design phase of the project. The project proponents would coordinate with the land-managing agencies to incorporate specific agency requirements into the COMP.

Operation, Maintenance, and Abandonment

Permitted Uses—After construction, compatible uses in the right-of-way on public lands would be considered and approved by the project proponents and the land-managing agency. Permission to use the right-of-way on private lands would have to be obtained from the owner of the transmission line. Generally, the individual landowner or land user retains the right to use the land in ways that do not interfere with the rights granted for the transmission line and consider the safety of humans and animals. Examples of uses generally permitted within the right-of-way include grazing, most crop production, vehicle access, low-growing trees, open storage areas, corrals, and stock tanks. Examples of prohibited uses include buildings or closed structures frequented by humans such as residences and any use requiring changes in surface elevation that would affect electrical clearances of existing or planned facilities.

Safety and Grounding—The design, operation, and maintenance of the project would meet or exceed all applicable criteria and requirements of FERC, WSCC, NESC, and U.S. Department of Labor Occupational Safety and Health Standards for safety and protection of landowners and their property. The transmission line would be protected with power circuit breakers and line relay protection equipment. If conductor failure occurred, power would be automatically removed from the line. Lightning protection would be provided by overhead ground wires along the line.

All buildings, fences, and other structures with metal surfaces located within 200 feet of the centerline of the right-of-way would be grounded. Typically, residential buildings located 200 feet from the centerline would not require grounding. Other buildings or structures beyond 200 feet would be reviewed in accordance with the NESC to determine grounding requirements. Also, all metal irrigation systems that parallel transmission lines for distances of 1,000 feet or more within 100 feet of the centerline would be grounded. If grounding were required outside the right-of-way, a temporary use permit or landowner consent would be obtained as necessary.

Maintenance—The 500kV transmission line would be inspected annually or as required by both ground and air patrols. Maintenance would be performed as needed, and the comfort and safety of local residents would be provided for by limiting noise, dust, and the danger caused by maintenance vehicle traffic.

Where access is required for nonemergency maintenance and repairs, the same precautions against ground disturbance that were taken during the original construction would be followed. The project proponents would comply with requirements of the land-managing agencies regarding management of noxious weeds within the right-of-way and transmission line access roads.

Emergency maintenance would involve prompt movement of repair crews to repair or replace any damaged equipment. Although restoration of the line would have priority, an effort would be made to protect crops, plants, wildlife, and other resources of significance. Restoration and reclamation procedures following completion of repair work would be similar to those prescribed for construction. Details would be provided in the COMP prior to construction of the transmission line.

Land within rights-of-way would not be chemically treated with herbicides or pesticides unless needed and only upon prior approval of the land manager or owner. The project proponents would comply with requirement of the land-managing agencies regarding management of noxious weeds along access roads, within the right-of-way, and at temporary use areas (e.g., cleaning equipment to prevent spread of noxious weeds). Chemical treatment within or adjacent to the right-of-way generally would be limited only to areas with noxious weeds.

Inspection and maintenance of the building, communication tower, and other physical equipment would occur periodically. Maintenance of the communication facilities would consist of testing, repairing, and replacing electronic equipment located within the building at the communication site. Sites accessible by road would be patrolled and monitored by maintenance personnel.

The 500kV substation yards are inspected weekly, requiring one person one day to accomplish. Each gas circuit breaker undergoes routine annual inspections and maintenance, requiring three people one day to accomplish. The power transformers receive annual maintenance taking two people about one-half day to complete. Capacitors are maintained annually, requiring three people one day to complete.

Abandonment—At the end of the useful life of the proposed project (estimated to be at least 50 years), if the transmission line and associated facilities were no longer needed, the facilities would be abandoned. The project proponents would coordinate with the appropriate land-managing agencies to develop a plan for the abandonment. For example, all equipment not needed would be dismantled and removed, and tower structures would be removed and foundations broken off below ground surface. If the line and associated right-of-way were abandoned at some future date, the right-of-way would be available for the same uses that existed before construction of the project. Following abandonment and removal of the transmission line from the right-of-way, any areas disturbed would be restored and rehabilitated as near as possible to their original condition.

ESTIMATED COST

Cost estimates have been prepared and updated throughout the development of NTP. The route preferred by the proponents for construction has not been selected; however, cost estimates for alternative routes addressed in this DEIS have been prepared, and the average cost (in constant 1995 dollars) for the alternative routes would be approximately $332 million ($248 million for the transmission line and $84 million for the substations). The cost estimates were prepared using unit costs and assumptions typical for estimating such facilities. The cost estimates were reviewed by independent consultants and updated by Western.

ALTERNATIVE ROUTES

A number of alternative routes for the proposed transmission line were identified, studied, assessed, and compared. The objective was to identify the environmentally preferred route from Shiprock Substation in northwestern New Mexico to either the Mead or the Marketplace substation in southeastern Nevada. This section summarizes the process followed and the results leading to and included in the comparison of alternative routes, presents the environmentally preferred route, and explains the decisions to be made regarding the proposed action. The information here focuses on only the alternative routes addressed and compared in this DEIS (approximately 1,022 miles of routes), and does not address any of the alternatives that were studied but eliminated from further consideration (see Appendix B).

Environmental analyses also were completed for the substation sites and communication site being considered. The substation site selected would depend on the route selected for construction of the transmission line. At the western terminus, both the Mead and the Marketplace substations remain as options until utility participation in one or the other of the substations is determined. As mentioned previously, the only microwave communication facilities needed would be to support the potential Red Lake Substation. If the Red Lake Substation were selected, microwave equipment would be installed at existing microwave communication facilities and within the Red Lake Substation yard. For these reasons, only the alternative routes are addressed.

Process

Each step of the process, as shown in Figure 2-9, is briefly summarized below and explained in more detail in Appendix A.

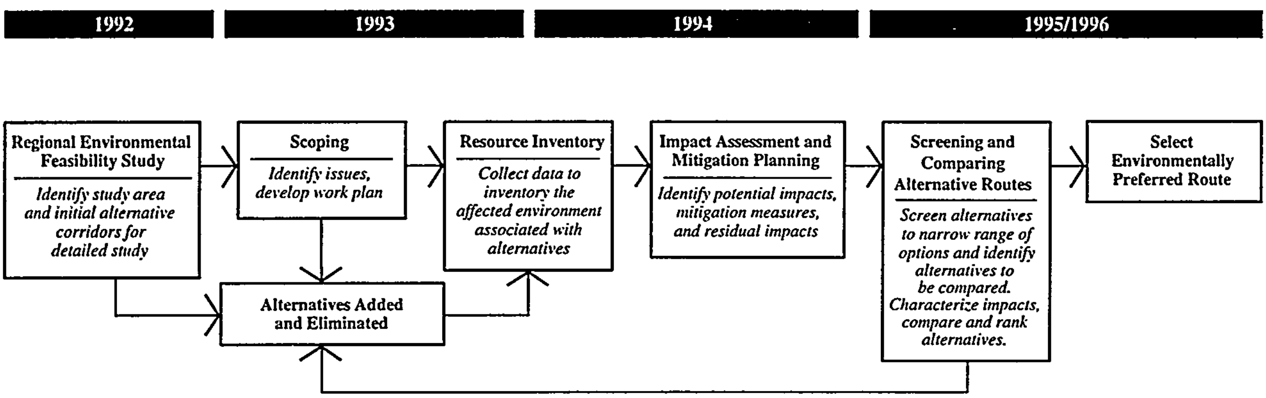


FIGURE 2-9
ENVIRONMENTAL PROCESS

Regional Environmental Feasibility Study The environmental work began with a regional environmental feasibility study to identify potential corridors feasible for constructing a transmission line. The majority of the corridors identified parallel existing linear facilities such as transmission lines, pipelines, or fiber optic cable. The results of the study were documented in the *Navajo Transmission Project Environmental Feasibility Study* (June 1992).

Scoping The locations of the alternative routes were refined and then reviewed by the public and relevant agencies through scoping (Chapter 5), which initiated the NEPA process. The process and results are documented in the *Navajo Transmission Project Scoping Report* (January 1994). As a result of scoping, several alternative routes were eliminated and others were added (Appendix B) to establish the network of alternative routes and ancillary facilities (substations and a communication site) to be studied.

Resource Inventory Each alternative route was inventoried to establish a baseline of existing environmental resources. Through scoping and resource inventory, a number of environmental issues were identified (Table 2-6). These environmental issues influenced the direction of the analyses and criteria for assessing impacts.

Impact Assessment and Mitigation Planning The alternative routes were assessed to identify the potential effects that the proposed project could have on the resources. Where warranted, measures to mitigate the impacts were selectively recommended. Table 2-7 (at the end of this chapter) provides a list of the selective mitigation measures, a general description of each measure's effectiveness, and the resources for which each measure was employed. The impacts remaining after mitigation was applied are referred to as residual impacts. The *Navajo Transmission Project Mitigation Plan* (September 1996) was prepared to document the environmental impacts and the mitigation measures committed to in the DEIS.

Screening and Comparison Through a systematic analysis, all of the alternative routes studies were screened and compared in order to narrow the number of alternative routes (Appendix B) and determine the most environmentally acceptable routes addressed in the DEIS.

Selection of Environmentally Preferred Route The remaining alternatives were ranked for preference. The alternative routes in the east and west with the least overall impact on the environment were selected as the environmentally preferred.

TABLE 2-6 ENVIRONMENTAL ISSUES AND CONCERNS	
Eastern Area	
Resource Issue	**Comment/Concern**
Water and Soils	■ impacts at river crossings (San Juan River, Colorado River, Little Colorado River)
Biological	■ riparian areas ■ habitat fragmentation ■ threatened and endangered fish species at river crossings ■ special status species ■ big game habitat ■ effects on biodiversity and habitat in the Chuska Mountains ■ Glen Canyon NRA - impacts on peregrine falcon, goshawk, threatened and endangered species plants ■ The Hogback Area of Critical Environmental Concern (ACEC) (sensitive plant species)
Land Use	■ follow existing corridors ■ develop reasonable range of alternatives as Navajo-Hopi land dispute could affect implementation of the project ■ residences and agriculture ■ proximity to towns of Waterflow, Lukachukai, Many Farms, Page, and Lechee ■ timber management area in Buffalo Pass ■ Turquoise planning area - Hopi comprehensive plan ■ future development in Page ■ restrictions of right-of-way on future land uses ■ uranium mining reclamation areas
Parks, Preservation, and Recreation	■ Monument Valley Tribal park ■ recreational uses around Page
Visual	■ Class A scenery in Buffalo Pass, Marsh Pass/northern Black Mesa ■ views from State Register District at Mitten Rock ■ views from NPS administered lands - Glen Canyon NRA, the Flagstaff areas, National Monuments ■ visual concerns in the Page area ■ visual effects - presence of line
Cultural	■ areas of regional customary and ceremonial significance (Marsh Pass area, Chuska Mountains, Chuska Valley, Black Mesa) ■ Navajo (Comb Ridge) and Hopi traditional cultural places (eagle nesting, pilgrimage trails) ■ The Hogback National Register District, Chaco Protection Site
Other	■ electric and magnetic field (EMF) effects on humans and animals

TABLE 2-6
ENVIRONMENTAL ISSUES AND CONCERNS

Western Area	
Resource Issue	**Comment/Concern**
Water and Soils	■ river crossings (Colorado River) ■ erosive soils in Truxton Plain area
Biological	■ sensitive habitat for desert bighorn sheep, desert tortoise, nesting bald eagles in Lake Mead NRA ■ raptor habitat in the Aubrey Cliffs ■ black-footed ferret reintroduction in Aubrey Valley ■ Wright Canyon ACEC ■ Cottonwood-Wright Creek ACEC ■ Black Mountain ACEC (bighorn sheep) ■ habitat fragmentation ■ big game (pronghorn antelope) habitat in Truxton Plain area ■ Eldorado Mountains (wild burros) ■ Eldorado Valley (desert tortoise)
Land Use	■ follow existing corridors ■ Chemstar Lime Mine ■ conflicts in Hackberry area
Parks, Preservation, and Recreation	■ impacts on Arizona Trail and Moqui Stage Station ■ Lake Mead NRA
Visual	■ views from NPS administered lands (Lake Mead NRA, Grand Canyon, and Flagstaff areas) ■ visual effects - presence of lines ■ US 180/AZ 64, Diamond Creek Road, Beale Wagon Road ■ Grand Canyon Railroad ■ visual quality in Truxton Plains
Cultural	■ areas of regional customary and ceremonial significance to Hualapai and Navajo tribes (traditional cultural places) ■ Milkweed Canyon ceremonial site ■ Grand Canyon Railroad and Beale Wagon Road ■ Historic Route 66
Other	■ EMF effects on humans and animals

Results

For ease of comparison and presenting the results, the project area was divided into two areas of alternatives: eastern and western. The Moenkopi Substation represents the endpoint of the eastern alternatives and beginning point of western alternatives in the network of alternative routes. The alternative routes addressed in the DEIS are shown in Figures 2-10 and 2-11 (at the end of this chapter). Table 2-8 lists the alternative routes and the links (segment of route between two nodes) that make up each route (the links are labeled with numbers from east to west). A description of each alternative route accompanied by representative photographs is provided in Appendix C.

TABLE 2-8
ALTERNATIVE ROUTES COMPARED

Alternative Route	Length (miles)	Links
Eastern Area Alternatives		
Glen Canyon 1 (GC1)	260.6	100, 120, 460, 461, 463, 501, 502, 504, 561, 580, 581, 586, 587, 620, 621, 627 ,1389, 1393, 1397, 1383,1384, 1386
Kaibito 1 (K1)	244.7	100, 120, 460, 461, 463, 501, 502, 504, 561, 580, 581, 586, 1390, 1391, 1393, 1397, 1383, 1384, 1386
Central 1 (C1)	186.7	180, 240, 300, 360, 640, 700, 701, 780
Central 2 (C2)	211.0	100, 120, 460, 462, 780
Western Area Alternatives		
Moenkopi to Marketplace		
Northern 1 West (N1W)	217.0	1400, 1401, 1660, 1740, 1741, 1790, 2060, 2200, 2180
Northern 2 (N2)	225.1	1400, 1401, 1660, 1740, 1741, 1742, 1800, 1980, 2020, 2060, 2200, 2180
Southern 2 (S2)	247.7	1420, 1421, 1480, 1520, 1640, 1680, 1720, 1960, 2000, 2002, 2006, 2020, 2060, 2200, 2180
Moenkopi to Mead		
Northern 3 (N3)	199.3	1400, 1401, 1660, 1740, 1741, 1790, 2040, 2080
Northern 4 (N4)	207.4	1400, 1401, 1660, 1740, 1741, 1742, 1800, 1980, 2020, 2040, 2080
Southern 4 (S4)	230.0	1420, 1421, 1480, 1520, 1640, 1680, 1720, 1960, 2000, 2002, 2006, 2020, 2040, 2080
Note: A link is a segment of route between two nodes.		

The study results are shown in a number of tables and figures at the end of this chapter. The tables and figures reflect the inventory data, impact data, and key issue areas that were integral elements in comparing and ranking the alternative routes. Table 2-9 summarizes the total number of miles for which each was recommended and committed along each alternative route. The remainder of the tables and figures are at the end of this chapter. Tables 2-10 and 2-11 summarize the inventory of resources present along each alternative route. This information served as the baseline indication of the condition of the environment as it currently exists. Tables 2-12 and 2-13 summarize the potential impacts on the resources that could result from the proposed project. Figures 2-12 and 2-13 show key issue areas. These areas are based on (1) areas of concern or interest expressed by agencies, the public, and/or project team resource specialists; and (2) locations of high and/or potentially significant adverse impacts. The issues and impacts were addressed and mitigated through use of selective mitigation measures. Only a few issue areas that could not be wholly resolved at this stage of the project are shown on Figures 2-12 and 2-13. Issue areas were examined as the alternative routes were compared and ranked for preference.

The results of comparing and ranking the alternative routes are shown in Tables 2-14 and 2-15. (Refer to Tables A-2 and A-3 for more detailed descriptions of the alternative routes for each resource.) The tables show the rankings of each alternative for each resource, as well as overall preferences for each alternative route. The overall preference is a combination of preferences for (1) traditional cultural places and (2) all other environmental resources. The route comparisons based on potential impacts on traditional cultural places were separately displayed because of the particular concern of the Navajo Historic Preservation Department, Hopi Tribe, and Hualapai Tribe.

Consideration of impacts on traditional cultural places was based on three special studies that addressed traditional Navajo, Hopi, and Hualapai cultural places. Inventory information is incomplete and often confidential, but with involvement of members of each tribe, the best available information was compiled and sensitivity and impact models were developed for valued traditional cultural places. More detailed inventory, evaluation, and impact assessment would be required along any route approved for construction, and potential mitigation measures would be investigated further. The potential for mitigating impacts on traditional cultural places is poorly understood at this time, and many impacts may be largely unmitigable. Therefore, the impacts on traditional cultural places were given more consideration than more readily mitigable potential impacts on other types of environmental resources.

Through siting and mitigation, the majority of impacts on resources would be low with some moderate, except for visual resources and traditional cultural places. This is illustrated in the shaded columns of Tables 2-14 and 2-15. Residual high impacts on areas of visual resources and traditional cultural places were important in considering the overall ranking of the alternatives because these impacts reflect locations where, even with mitigation applied, impacts remain high.

Environmentally Preferred Alternative Route

In the eastern area, the environmentally preferred route is Kaibito 1 (K1), which would connect the Shiprock Substation with either the Red Mesa, Copper Mine, or Moenkopi Substation site. K1 would parallel the Shiprock-to-Glen Canyon 230kV line and the Glen Canyon-to-Pinnacle Peak 345kV line for

TABLE 2-9 MILES OF MITIGATION ALONG THE ALTERNATIVE ROUTES													
Alternatives (length in miles)	Selective Mitigation Measures (refer to Table 2-7)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Eastern Area Alternatives													
GC1 (260.6)	31.1	41.7	34.7	—	209.5	11.5	8.2	3.8	253.6	8.8	15.4	15.5	—
K1 (244.7)	27.9	55.2	50.2	—	175.1	10.7	3.8	3.3	237.7	8.8	15.4	13.2	—
C1 (186.7)	113.5	9.5	25.4	—	177.8	11.0	170.1	2.0	186.7	14.6	2.0	14.4	6.8
C2 (211.0)	103.4	62.8	47.5	—	140.9	7.9	96.5	3.3	204.0	3.8	2.4	3.0	—
Western Area Alternatives													
Moenkopi to Marketplace													
N1W (217.0)	72.1	27.4	23.8	14.5	151.3	13.6	150.4	3.1	150.4	32.8	—	16.1	50.9
N2 (225.1)	54.7	44.7	57.8	30.5	126.5	12.1	125.2	2.5	166.7	38.6	5.5	22.6	26.5
S2 (247.7)	47.3	43.0	42.1	14.5	134.0	13.8	127.4	3.4	208.0	42.7	0.6	17.4	20.4
Moenkopi to Mead													
N3 (199.3)	61.2	17.5	10.3	—	144.1	13.2	144.1	3.4	144.1	18.0	—	2.4	50.9
N4 (207.4)	43.8	34.8	44.3	16.0	119.3	11.7	118.9	2.8	160.4	23.8	5.5	8.9	26.5
S4 (230.0)	36.4	33.1	28.6	—	126.8	13.4	121.1	3.7	201.7	27.9	0.6	3.7	20.4
Note: This table summarizes the total number of miles for which each measure was recommended and committed along each alternative route.													

the majority of its length (about 73 percent). High adverse impacts on visual resources would be concentrated in the Kayenta area resulting from introduction of a new transmission line corridor in an area of high scenic quality and potential foreground views from residences. High adverse impacts on Navajo and Hopi traditional cultural places would be minimized using K1 by avoiding the issue areas of the Chuska Valley, Chuska Mountains, and southern portion of Black Mesa, but would result in the area of northern Black Mesa and Marsh Pass. K1 was ranked the second preference for environmental resources (without consideration of traditional cultural places), first for traditional cultural places, and first overall.

In the western area, two environmentally acceptable routes were identified—Northern 1 West (N1W) and Northern 3 (N3). The two alternatives share the same route for about 152 miles of the eastern majority of the alternative and then diverge to either the Mead or the Marketplace substation. Both of these alternatives would parallel existing transmission lines over their entire lengths. N1W would parallel a 500kV line and connect the Moenkopi Substation site with the Marketplace Substation. Lake Mead NRA prefers N1W (the southern crossing of the Colorado River) because the terrain is less rugged, there is less sensitive habitat, and there is one existing 500kV transmission line crossing the river. N3 would connect the Moenkopi Substation site with the Mead Substation and uses the northern crossing of the Colorado River, which is traversed by two lines. N3 would parallel the Mead-to-Liberty 345kV line and the recently constructed Mead-to-Phoenix 500kV line, the access road of which was upgraded during construction. No high impacts would result along either of these alternatives, and both are preferred for traditional cultural places.

Decisions to Be Made

The final route for the transmission line has not been selected. Following the review of the DEIS, the comments on the DEIS and proposed action received from the public and agencies will be reviewed, analyzed, and incorporated as appropriate into the FEIS. The FEIS will be distributed to the public with a Record of Decision by the Administrator of Western.

The Record of Decision will:

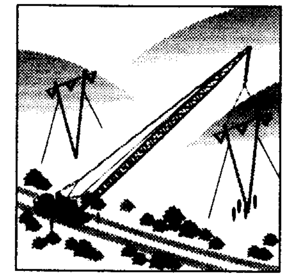
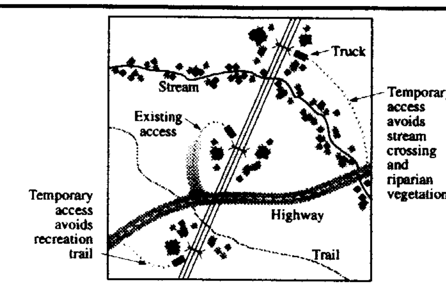
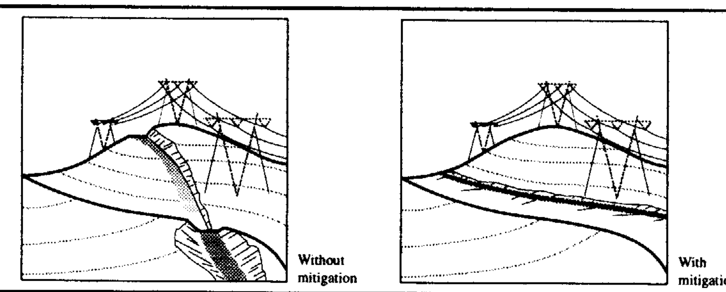
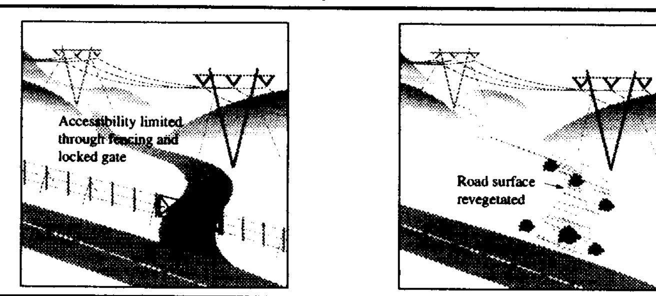
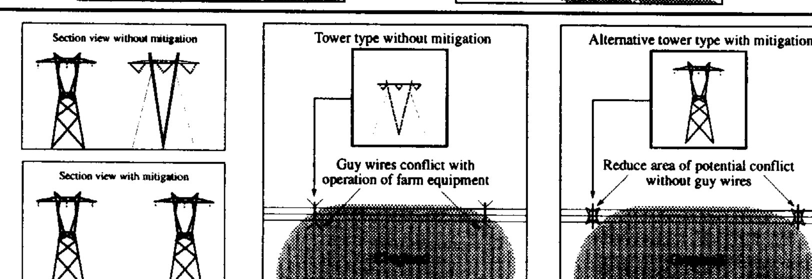
a) state what the decision is

b) identify all alternatives considered in reaching the decision. The Record of Decision will describe preferences among alternatives based on relevant factors including the following:
   - environmental acceptability
   - regulatory permitting (e.g., Federal, state, tribal, and local)
   - public, tribal, and agency preferences (e.g., DPA's initial position is to support the environmentally preferred alternative route pending final input from the public and Navajo chapters, committees, Council, President, etc.)
   - engineering (e.g., system considerations such as power flow and interconnections, length of route, construction difficulty, accessibility, extent of mitigation required, extent of design modifications)
   - right-of-way acquisition considerations (e.g., difficulty in acquisition, difficulty in scheduling)
   - agency statutory obligations

c) state whether all practical means to avoid or minimize harm from the alternative selected were adopted, and if not, why they were not. Also, once the final route has been selected a COMP would be developed, which will include mitigation and monitoring.

The Administrator will ensure that the decision is consistent with sound professional, business, and technical practices and that the decision is executed as stipulated.

MITIGATION EFFECTIVENESS

	MITIGATION MEASURE	MITIGATION EXAMPLES
1.	In areas where soils and vegetation (including timber) are particularly sensitive to disturbance, existing access roads will not be widened or otherwise upgraded for construction and maintenance, except in areas where repairs are necessary to make existing roads passable.	
2.	To avoid disturbance to sensitive features (e.g., perennial streams, recreation trails, irrigation canals), access roads will not be constructed in those areas. Rather, construction and maintenance traffic will use existing roads or cross-country access routes (including the right-of-way). To minimize ground disturbance, construction traffic routes must be clearly marked with temporary markers such as easily visible flagging. The construction routes or other means of avoidance must be approved in advance of use by the authorized officer.	
3.	To minimize ground disturbance and/or reduce scarring (visual contrast) of the landscape, the alignment of any new access roads or cross-country route will follow the landform contours in designated areas where practicable, providing that such alignment does not impact resource values additionally.	
4.	To limit new or improved accessibility into the area, all new access that is undesired or not required for maintenance will be closed using the most effective and least environmentally damaging methods appropriate to that area and developed with concurrence of the landowner or land manager.	
5.	To minimize ground disturbance, operational conflicts, and/or visual contrast, the tower design will be modified or an alternative tower type will be used.	

	Water Resources			Earth Resources	Biological Resources				Land Use						Visual Resources				
	Perennial Streams	Springs	100-Year Floodplains	Soils	Vegetation	Special Status Plants	Big Game	Special Status Wildlife	Existing Land Use	Residential	Grazing	Timber	Future Land Use	Parks, Preservation, and Recreation	Scenic Quality	Views from Residences	Views from High Sensitivity Roads	Views from Moderate Sensitivity Roads	Views from Recreation Areas
1.				●	●		●	●				●		●	●	●			
2.	●				●	●	●	●	●		●	●			●	●	●	●	●
3.				●	●		●				●			●	●	●	●	●	●
4.							●	●			●			●					
5.			●						●						●	●	●	●	●

	Mitigation Effectiveness
1.	Avoiding unnecessary access road upgrades leaves vegetation in place, thereby limiting the amount of habitat disturbed or removed and protecting underlying soil from accelerated erosion. In addition, not improving existing access roads, vehicular traffic does not increase appreciably and indirect effects such as damage or loss of vegetation, harassment of wildlife, vandalism of cultural resources, and disturbance of sensitive land uses (e.g., parks, preservation, recreation areas) are limited.
2.	Mitigation 2 is effective for the same reasons as Mitigation 1. In addition, minimizing ground-disturbing construction activities in the vicinity of streams or canals would protect the integrity of the riparian areas, stream banks, and streambeds, and avoid turbidity and sedimentation, which could affect aquatic ecology. Minimizing interference with certain land uses (e.g., recreation trails) and disruption of sensitive views also would occur.
3.	Following the natural contour of the land, particularly in steep terrain, minimizes the cutting and filling of slopes, and ensures that the form and line of the landscape is not visually interrupted. This results in reducing visual contrast between the exposed ground of the road and the surrounding environment (e.g., adjacent vegetation). Also, water runoff is less likely to accelerate soil erosion (minimizing potential damage from rutting, rilling), which in turn protects adjacent vegetation.
4.	Closing access roads where they are not needed after construction protects the resources in that area from further disturbance for the reasons described for Mitigation 1. Methods for road closure or management include installing and locking gates, obstructing the path (e.g., earthen berm, boulders), revegetating the surface of the roadbed to make it less apparent, or obliterating the road and returning it to its natural contour and vegetation.
5.	Flexibility in designing the tower or use of different tower types allows tower structures to be adapted to specific site situations. Examples follow. In agricultural areas, different tower types could be used to minimize interference with agricultural operations (e.g., a four-legged or H-frame structure would interfere less with operation of farm equipment than a structure requiring guy wires). In areas where there are sensitive views and the proposed line would parallel an existing line, matching the type of tower used along the existing line minimizes visual contrast; whereas two different tower types adjacent to one another would create a noticeable contrast in the landscape.

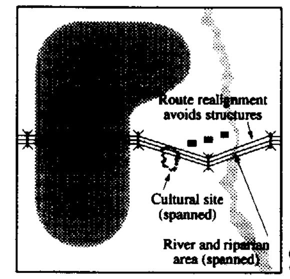
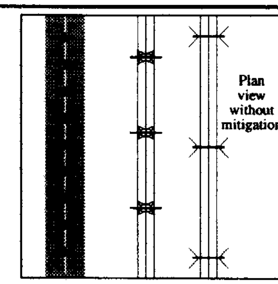
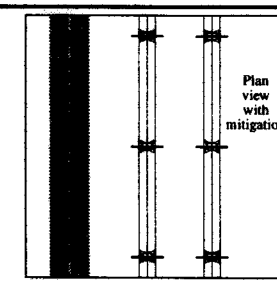
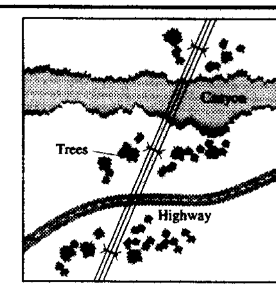
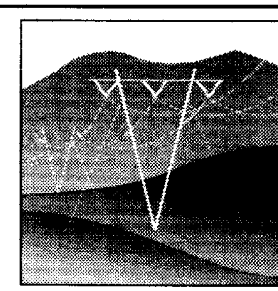
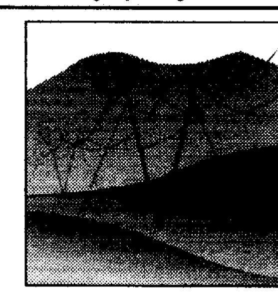
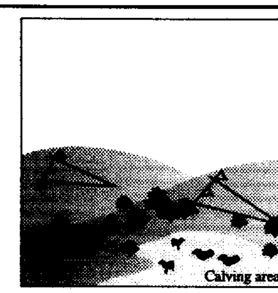
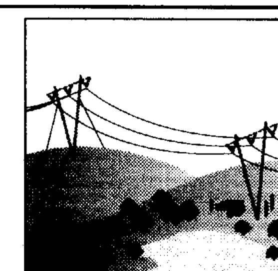
● indicates that the measure is employed to mitigate impacts on the resource

Selective Mitigation

Navajo Transmission Project

Table 2-7

MITIGATION EFFECTIVENESS

MITIGATION MEASURE	MITIGATION EXAMPLES	Water Resources			Earth Resources	Biological Resources				Land Use						Visual Resources					
		Perennial Streams	Springs	100-Year Floodplains	Soils	Vegetation	Special Status Plants	Big Game	Special Status Wildlife	Existing Land Use	Residential	Grazing	Timber	Future Land Use	Parks, Preservation, and Recreation	Scenic Quality	Views from Residences	Views from High Sensitivity Roads	Views from Moderate Sensitivity Roads	Views from Recreation Areas	
6. To minimize amount of sensitive features disturbed in designated areas structures and access roads will be placed so as to avoid sensitive features such as, but not limited to, riparian areas, water courses, agricultural lands, residential uses, and cultural sites, and/or to allow conductors to clearly span the features, within limits of standard tower design. Avoidance may be accomplished by spanning sensitive features, shifting the alignment to the opposite side of an existing line, or realigning the route.	 Construction with mitigation	●	●	●		●	●		●	●	●										Flexibility in the placement of towers allows for sensitive features to be avoided. Examples follow. Placing towers outside and on either side of a sensitive feature, the conductors span over the sensitive area. Spanning perennial streams, springs, and 100-year floodplains minimizes potential degradation of the water quality from increased sedimentation in drainages, stream-bank erosion, and possible adverse changes to river flow and depositional patterns in the drainages. Minimizing disturbance to highly erosive soils, sensitive vegetation, habitat, or special status plants by spanning or using fewer towers reduces possible loss. Also, realigning the towers along a route or realigning the route can result in avoiding or minimizing direct impacts on resources such as cultural and biological resources, and land uses such as residences, parks, and preservation and recreation (e.g. trails) areas.
7. To reduce visual contrast and/or potential operational conflicts, standard tower design will be modified to correspond with spacing of existing transmission line structures where feasible and within limits of standard tower design. The normal span will be modified to correspond with existing towers, but not necessarily at every location.	 															●	●	●	●	●	Matching tower spacing with existing parallel lines reduces the visual space occupied by the towers and minimizes the amount of contrast between the man-made structures and the landscape.
8. To reduce visual impacts, potential impacts on recreation values and safety at highway, canyon, and trail crossings, towers are to be placed at the maximum feasible distance from the crossing within limits of standard tower design.	 Towers placed maximum distance from canyon and highway crossings														●			●	●	●	Placing towers a maximum distance from major or sensitive crossings (e.g., roads, trails) reduces the impact of the structure on the viewers (e.g., motorists, recreationists) and reduces potential safety hazards (e.g., vehicle colliding into tower).
9. "Dulled" metal finish on towers will be used to reduce visual impacts.	 Without mitigation shiny towers are more visible  With mitigation dulled towers blend into background															●	●	●	●	●	Use of specially treated or coated tower components to dull the surfaces of the towers decreases reflection, minimizes the contrast of the transmission line in the landscape, and reduces impacts on viewers.
10. With the exception of emergency repair situations, the construction, restoration, maintenance, and termination activities in designated areas will be modified or curtailed during sensitive periods (e.g., nesting and breeding periods) for candidate, proposed threatened and endangered, or other sensitive animal species. Sensitive periods and areas of concern would be approved in advance of construction or maintenance by the authorized officer.	 Construction activities suspended during sensitive breeding periods  Construction activities resumed following calving period							●	●						●						Curtailing construction activities during breeding, lambing, and nesting periods eliminates potential disturbance of special status wildlife or big game during these critical periods of their life cycles.

● indicates that the measure is employed to mitigate impacts on the resource

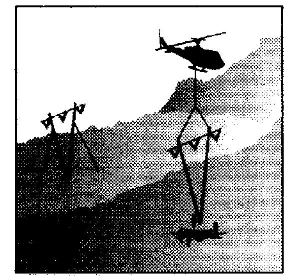
Selective Mitigation

Navajo Transmission Project

Table 2-7

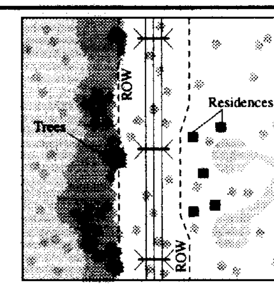
MITIGATION MEASURE / MITIGATION EXAMPLES / MITIGATION EFFECTIVENESS

11. Helicopter placement of towers will be used to reduce impacts subject to field review.



Using helicopters to place towers in steep terrain or otherwise sensitive areas greatly reduces the amount of area and resources disturbed by construction activities. Reducing ground disturbance reduces the loss of vegetation, accelerated soil erosion, potential damage to cultural resources, and scarring of the land surface, thereby reducing visual contrast.

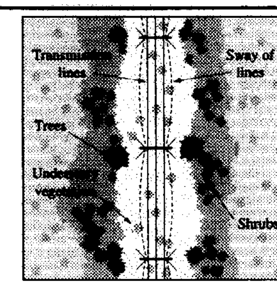
12. To reduce visual contrast or avoid features (such as, but not limited to, land uses, jurisdiction, biological or cultural resources sites), clearing of the right-of-way will be minimized or in limited instances the right-of-way may be reduced (within the limits of conductor-clearance requirements and standard tower design).



Right-of-way reduced to avoid residences and reduce vegetation clearing

Limiting the width of the area cleared in the right-of-way reduces the amount of vegetation (including trees) removed at the edges of and within the right-of-way, minimizing the loss of habitat and reducing visual contrast between the cleared areas and the surrounding environment. In limited circumstances, the width of the right-of-way may be reduced to accommodate a land use.

13. To minimize disturbance to timber resources and reduce visual contrast, clearing of trees in and adjacent to the right-of-way will be minimized to the extent practicable to satisfy conductor-clearance requirements (National Electric Safety Code and 10 years of timber growth). Trees and other vegetation will be removed selectively (e.g., edge feathering) to blend the edge of the right-of-way into adjacent vegetation patterns, as practicable and appropriate.



Clearing of trees minimized

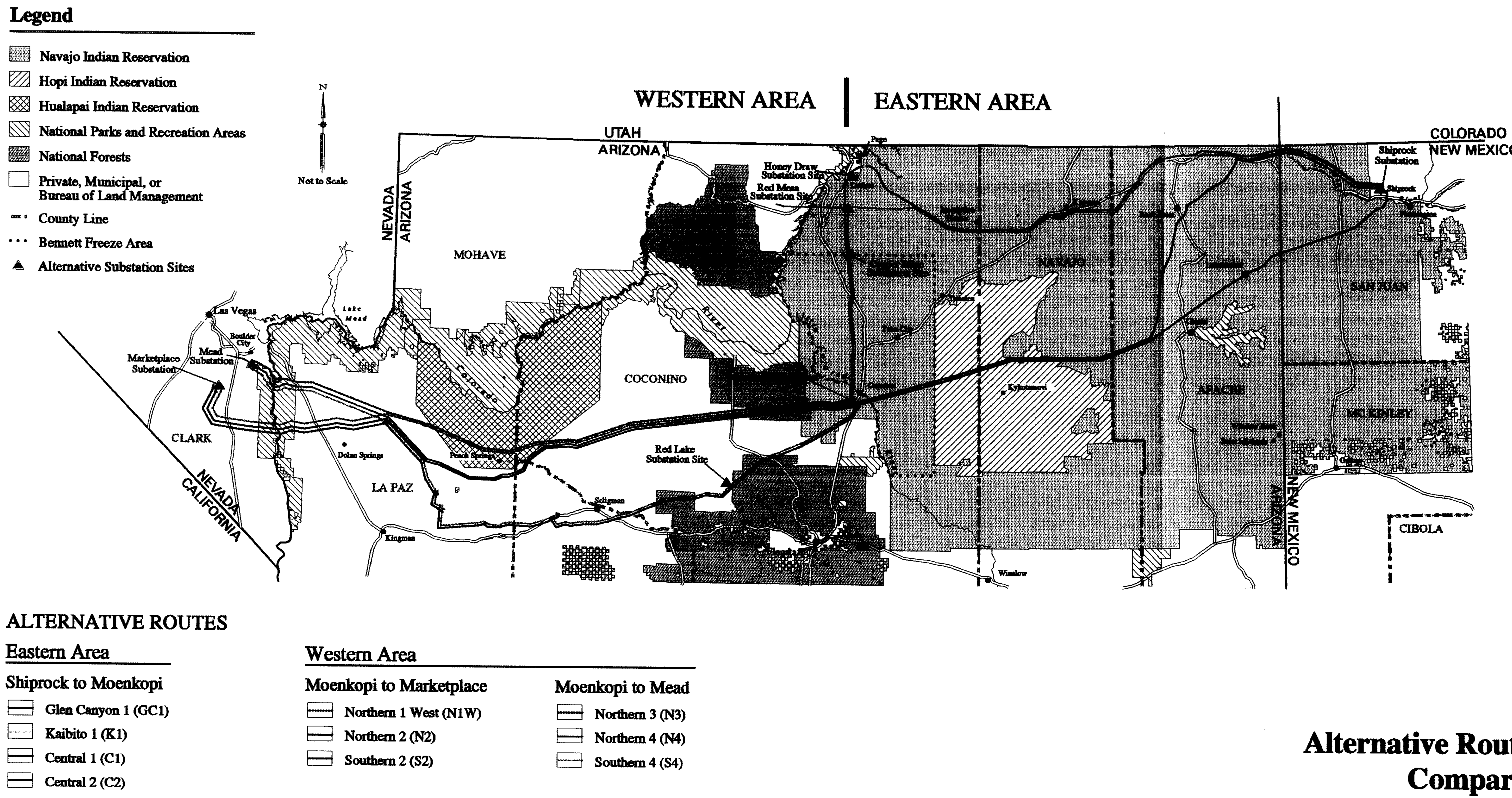
Selectively removing vegetation (including trees) within and along the edges of the right-of-way reduces disruption of habitat, minimizes removal of timber resources, and reduces the visual contrast between the right-of-way and the surrounding environment. Rather than cutting trees and other vegetation in straight lines along the edges of the right of-way, "feathering" the edges results in a more gradual, imperceptible modification of the environment.

MITIGATION EFFECTIVENESS

Measure	Water Resources			Earth Resources	Biological Resources				Land Use						Visual Resources				
	Perennial Streams	Springs	100-Year Floodplains	Soils	Vegetation	Special Status Plants	Big Game	Special Status Wildlife	Existing Land Use	Residential	Grazing	Timber	Future Land Use	Parks, Preservation, and Recreation	Scenic Quality	Views from Residences	Views from High Sensitivity Roads	Views from Moderate Sensitivity Roads	Views from Recreation Areas
11															●	●	●	●	●
12					●		●	●	●				●	●					
13												●			●	●	●	●	●

● indicates that the measure is employed to mitigate impacts on the resource

Selective Mitigation
Navajo Transmission Project
Table 2-7



Alternative Routes Compared

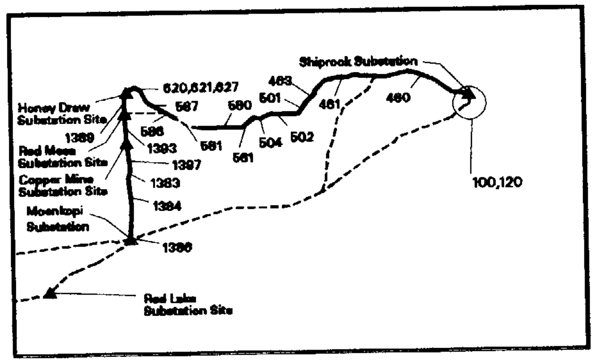
Navajo Transmission Project

Figure 2-10

EASTERN AREA

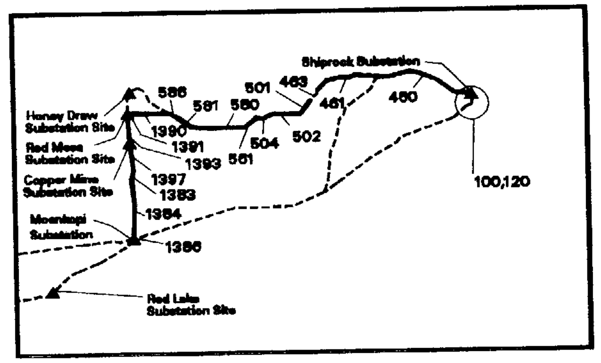
Shiprock to Moenkopi

GC1
100,120,460,461,463,501,502,504,561,580,581,586
587,620,621,627,1389,1393,1397,1383,1384,1386



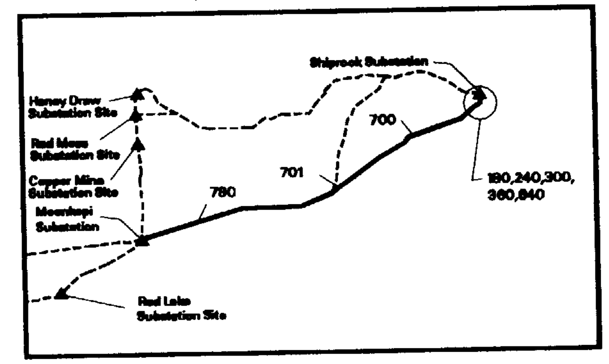
Total Length = 260.6 miles

K1
100,120,460,461,463,501,502,504,561,580,581
586,1390,1391,1393,1397,1383,1384,1386



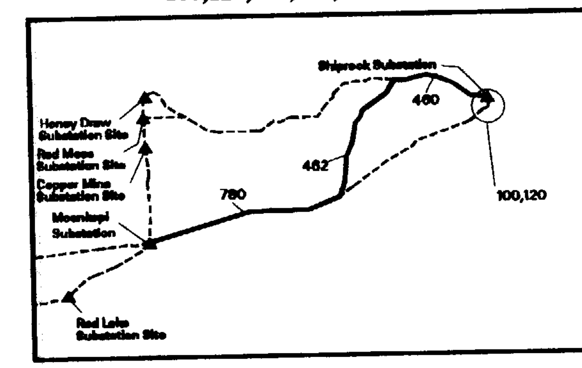
Total Length = 244.7 miles

C1
180,240,300,360,640,700,701,780



Total Length = 186.7 miles

C2
100,120,460,462,780

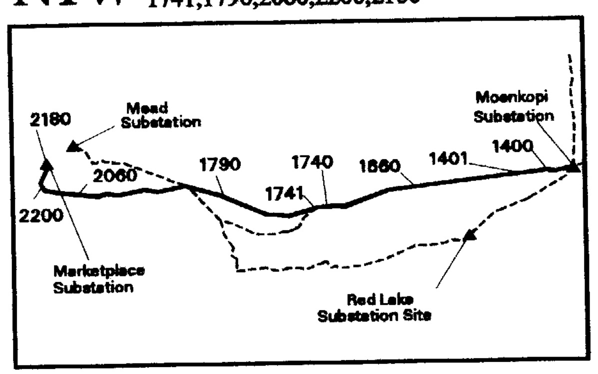


Total Length = 211.0 miles

WESTERN AREA

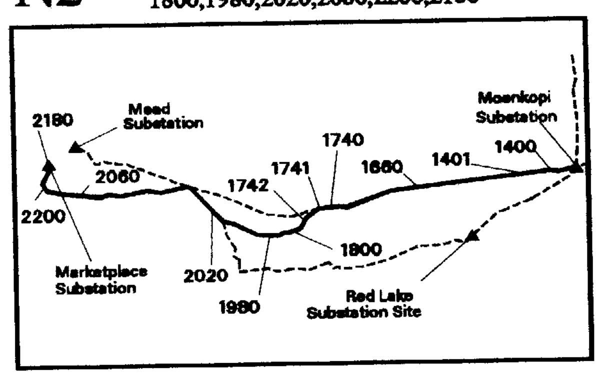
Moenkopi to Marketplace

N1W
1400,1401,1660,1740
1741,1790,2060,2200,2180



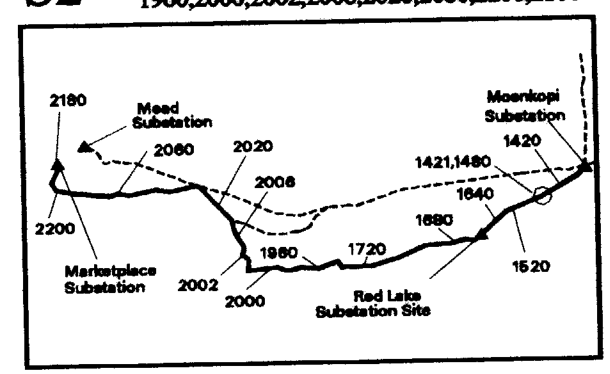
Total Length = 217.0 miles

N2
1400,1401,1660,1740,1741,1742
1800,1980,2020,2060,2200,2180



Total Length = 225.1 miles

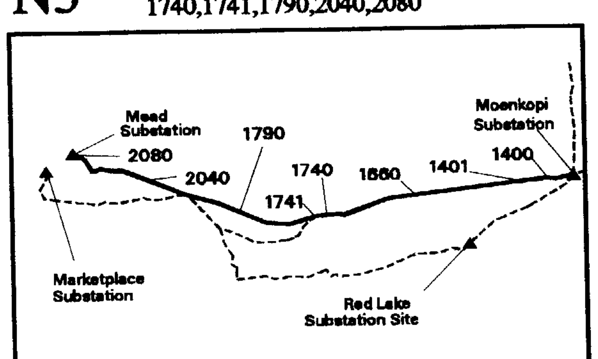
S2
1420,1421,1480,1520,1640,1680,1720
1960,2000,2002,2006,2020,2060,2200,2180



Total Length = 247.7 miles

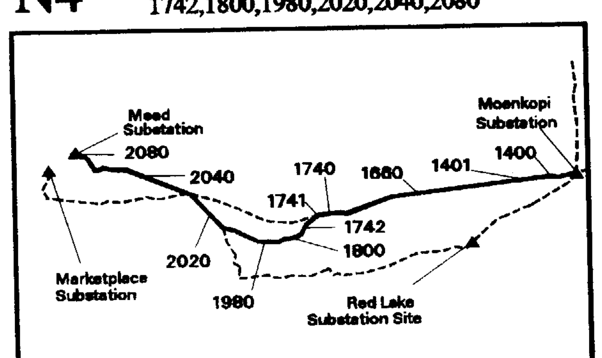
Moenkopi to Mead

N3
1400,1401,1660,
1740,1741,1790,2040,2080



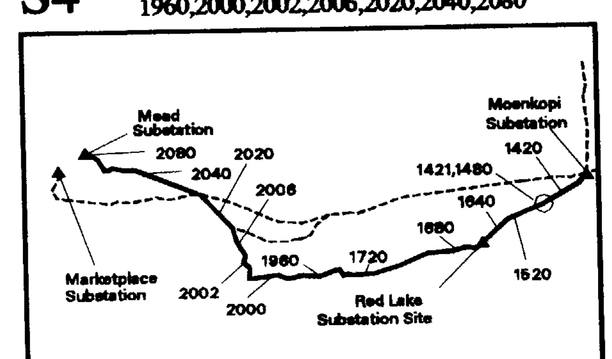
Total Length = 199.3 miles

N4
1400,1401,1660,1740,1741
1742,1800,1980,2020,2040,2080



Total Length = 207.4 miles

S4
1420,1421,1480,1520,1640,1680,1720
1960,2000,2002,2006,2020,2040,2080



Total Length = 230.0 miles

Alternative Route Schematics

Navajo Transmission Project
Figure 2-11

Alternative Routes	GENERAL: Length	GENERAL: New Corridor	GENERAL: Existing Transmission Line Corridor *	GENERAL: Other Linear Facilities (includes pipeline and fiber optic)	JURISDICTION: Private	JURISDICTION: State	JURISDICTION: Bureau of Land Management (includes land sale withdrawals)	JURISDICTION: Forest Service	JURISDICTION: National Park Service	JURISDICTION: Bureau of Reclamation	JURISDICTION: Navajo Nation	JURISDICTION: Hopi Tribe	JURISDICTION: Hualapai Tribe
GC1	260.6	49.7	210.9	–	1.9	0.2	3.4	–	–	–	255.1	–	–
K1	244.7	65.9	178.8	–	–	0.2	3.4	–	–	–	241.1	–	–
C1	186.7	8.9	176.3	1.5	1.7	–	2.1	–	–	–	150.7	33.1	–
C2	211.0	65.7	145.3	–	–	0.2	3.4	–	–	–	175.2	33.1	–

Alternative Routes	NATURAL ENVIRONMENT – Water Resources: Number of Perennial Stream Crossings	Water Resources: Number of Springs within 600 feet	Water Resources: 100-Year Floodplain Crossings	Soils: High/Severe Erosion Potential	Biological Resources – Vegetation: Riparian Areas	Vegetation: Ponderosa Pine	Vegetation: Known Habitat - Candidate Plant Species	Vegetation: Known Listed Plant Species	Biological Resources – Wildlife: Number of River Crossings Supporting Listed Species	Wildlife: Known Listed Species	Wildlife: Known Candidate/Other Species	Wildlife: Mojave Desert Tortoise Habitat	Wildlife: Sonoran Desert Tortoise Habitat	Wildlife: Black-footed Ferret - Reintroduction Area	Wildlife: Big Game Habitat	Paleontological Resources: Deposits of High Paleontologic Potential
GC1	1	2	2.2	181.5	3.5	–	2.6	4.4	1	6.5	10.2	–	–	–	62.6	196.7
K1	1	3	2.0	172.6	3.4	–	2.6	4.4	1	6.5	10.2	–	–	–	62.6	194.7
C1	1	5	4.1	126.2	1.9	6.8	1.6	2.1	1	9.5	14.5	–	–	–	103.9	160.5
C2	1	2	3.6	116.9	1.7	–	2.6	4.4	1	0.9	7.6	–	–	–	87.5	170.9

Alternative Routes	HUMAN ENVIRONMENT – Land Use – Productivity: Grazing (in acres)	Productivity: Timber Production (in acres)	Productivity: Irrigated Farmland	Productivity: Nonirrigated Farmland	Existing and Future: Number of Houses - 0 to 500-foot Corridor	Existing and Future: Planned Industrial/Commercial	Existing and Future: Planned Open Space	Existing and Future: Community Planning Areas	Existing and Future: Subdivided Lands	Recreation: Designated Recreation Areas	Recreation: Designated Preservation Areas	Visual Resources – Scenic Quality: Class A Scenic Quality	Scenic Quality: Class B Scenic Quality	Foreground Views (0-0.5 mile): Views from Residences	Foreground Views: Views from High Sensitivity Roads	Foreground Views: Views from Moderate Sensitivity Roads	Foreground Views: Views from Recreation Areas	Foreground Views: Views from Recreation Trails	Management Objectives: Retention Areas (Forest Service)	Management Objectives: Partial Retention Areas (Forest Service)	Management Objectives: Class I Areas (BLM)	Management Objectives: Class II Areas (BLM)
GC1	134.9	–	–	–	21	0.9	0.8	4.4	–	–	3.6	19.2	122.0	72.5	15.7	27.0	–	3.2	–	–	–	–
K1	152.3	–	–	–	19	–	–	–	–	–	3.6	18.3	108.6	63.8	5.9	27.0	–	3.2	–	–	–	–
C1	86.2	50.9	1.6	0.8	32	–	–	21.8	–	–	1.1	10.4	53.7	67.1	3.3	6.2	0.1	1.0	–	–	–	0.6
C2	153.4	–	–	0.3	10	–	–	21.8	–	–	3.6	5.2	84.3	58.3	1.1	12.1	0.1	1.0	–	–	–	–

Alternative Routes	CULTURAL ENVIRONMENT – Archaeology and History: High Sensitivity Areas	Archaeology and History: Moderate Sensitivity Areas	Special Status Sites (occurrences): National Monuments, Landmarks, Historic Roads, and Chaco Protection Sites	Special Status Sites: National Register Sites, Tribal Parks, Chaco Canyon Protection Site Candidates	Special Status Sites: State Register Sites/Other Protected Areas	Traditional Cultural Places: Navajo - High Sensitivity Areas	Traditional Cultural Places – Hopi: High Sensitivity Areas	Hopi: Number of Ritual Places	Hopi: Number of Nonritual Places	Traditional Cultural Places: Hualapai - High Sensitivity Areas
GC1	75.4	113.1	–	1	–	54	114	48	12	–
K1	75.4	97.2	–	1	–	54	99	44	13	–
C1	76.8	103.9	–	2	2	91	170	64	5	–
C2	27.2	154.0	–	2	–	88	162	66	4	–

Numbers represent miles crossed unless otherwise indicated.
* May include portions of pileline and/or fiber optic line corridor.

Summary of Inventory Data

Eastern Area Alternatives

Navajo Transmission Project

Table 2-10

		GENERAL				JURISDICTION										NATURAL ENVIRONMENT			
																Water Resources			Soils
	Alternative Routes	Length	New Corridor	Existing Transmission Line Corridor *	Other Linear Facilities (includes pipeline and fiber optic)	Private	State	Bureau of Land Management (includes land sale withdrawals)	Forest Service	National Park Service	Bureau of Reclamation	U.S. Army Corp of Engineers	Navajo Nation	Hopi Tribe	Hualapai Tribe	Number of Perennial Stream Crossings	Number of Springs within 600 feet	100-Year Floodplain Crossings	High/Severe Erosion Potential
Moenkopi to Marketplace	N1W	217.0	--	217.0	--	71.5	16.7	49.2	19.1	10.9	0.4	0.3	13.3	--	35.1	1	1	9.4	37.5
	N2	225.1	41.5	183.6	--	87.3	20.1	73.2	19.1	10.9	0.4	0.3	13.3	--	--	1	--	10.2	39.6
	S2	247.7	15.9	161.4	70.4	81.7	56.1	58.2	20.6	10.9	0.4	0.3	19.5	--	--	1	--	5.7	29.8
Moenkopi to Mead	N3	199.3	--	199.3	--	61.6	18.2	33.4	19.1	13.3	4.6	0.2	13.3	--	35.1	1	1	8.9	39.6
	N4	207.4	41.5	165.9	--	77.4	21.6	57.4	19.1	13.3	4.6	0.2	13.3	--	--	1	--	9.7	41.7
	S4	230.0	15.9	143.7	70.4	71.8	57.6	42.4	20.6	13.3	4.6	0.2	19.5	--	--	1	--	5.2	31.9

		NATURAL ENVIRONMENT												HUMAN ENVIRONMENT								
		Biological Resources											Paleontological Resources	Land Use								
		Vegetation				Wildlife								Productivity				Existing and Future				
	Alternative Routes	Riparian Areas	Ponderosa Pine	Known Habitat - Candidate Plant Species	Known Listed Plant Species	Number of River Crossings Supporting Listed Species	Known Listed Species	Known Candidate/Other Species	Mojave Desert Tortoise Habitat	Sonoran Desert Tortoise Habitat	Black-footed Ferret - Reintroduction Area	Big Game Habitat	Deposits of High Paleontologic Potential	Grazing (in acres)	Timber Production (in acres)	Irrigated Farmland	Nonirrigated Farmland	Number of Houses - 0 to 500-foot Corridor	Planned Industrial/Commercial	Planned Open Space	Community Planning Areas	Subdivided Lands
Moenkopi to Marketplace	N1W	2.0	--	2.7	--	1	23.2	15.0	21.1	1.0	20.7	139.4	78.5	105.9	56.4	--	--	--	--	--	8.6	0.2
	N2	2.0	--	2.7	--	1	38.8	20.1	21.1	1.0	15.3	148.3	75.6	155.3	56.4	--	--	1	--	--	8.6	1.0
	S2	2.3	--	6.8	--	1	23.2	22.5	21.1	1.0	--	113.3	62.3	166.2	60.7	--	--	7	--	--	19.6	1.9
Moenkopi to Mead	N3	3.3	--	2.7	--	1	8.3	20.1	5.7	6.4	20.7	140.4	78.5	78.8	56.4	--	--	--	--	--	--	--
	N4	3.3	--	2.7	--	1	8.4	25.2	5.7	6.4	15.3	148.9	75.6	128.2	56.4	--	--	1	--	--	--	0.8
	S4	3.6	--	6.8	--	1	8.3	27.6	5.7	6.4	--	113.9	62.3	139.2	60.7	--	--	7	--	--	11.0	1.7

		HUMAN ENVIRONMENT													CULTURAL ENVIRONMENT									
		Land Use		Visual Resources											Archaeology and History		Special Status Sites (occurrences)			Traditional Cultural Places				
		Recreation		Scenic Quality		Foreground Views (0-0.5 mile)					Management Objectives										Hopi			
	Alternative Routes	Designated Recreation Areas	Designated Preservation Areas	Class A Scenic Quality	Class B Scenic Quality	Views from Residences	Views from High Sensitivity Roads	Views from Moderate Sensitivity Roads	Views from Recreation Areas	Views from Recreation Trails	Retention Areas (Forest Service)	Partial Retention Areas (Forest Service)	Class I Areas (BLM)	Class II Areas (BLM)	High Sensitivity Areas	Moderate Sensitivity Areas	National Monuments, Landmarks, Historic Roads, and Chaco Protection Sites	National Register Sites, Tribal Parks, Chaco Canyon Protection Site Candidates	State Register Sites/Other Protected Areas	Navajo - High Sensitivity Areas	High Sensitivity Areas	Number of Ritual Places	Number of Nonritual Places	Hualapai - High Sensitivity Areas
Moenkopi to Marketplace	N1W	11.6	8.6	15.8	98.9	2.4	14.8	1.1	1.0	1.1	0.8	13.4	--	4.9	--	89.6	--	--	1	16	24	1	1	60
	N2	11.6	8.6	14.3	89.6	4.8	5.1	1.1	1.0	4.8	0.8	13.4	--	7.7	--	37.4	2	--	3	16	24	1	1	50
	S2	11.6	8.6	10.8	130.5	15.0	7.1	4.1	--	4.6	0.2	23.5	--	4.9	--	60.1	3	--	4	20	19	2	1	82
Moenkopi to Mead	N3	16.3	--	17.3	87.5	2.2	18.6	--	1.0	1.1	0.8	13.4	--	--	--	89.6	--	1	1	16	24	1	1	60
	N4	16.3	--	15.8	78.2	4.6	8.9	--	1.0	4.8	0.8	13.4	--	2.8	--	37.4	2	1	3	16	24	1	1	50
	S4	16.3	--	12.3	119.1	14.8	10.9	3.0	--	4.6	0.2	23.5	--	--	--	60.1	2	1	4	20	19	2	1	82

Numbers represent miles crossed unless otherwise indicated.

* May include portions of pileline and/or fiber optic line corridor.

Summary of Inventory Data

Western Area Alternatives

Navajo Transmission Project

Table 2-11

Alternative Routes	Length	Impact Level	NATURAL ENVIRONMENT									HUMAN ENVIRONMENT								CULTURAL ENVIRONMENT						
			Water Resources			Soils	Biological Resources				Paleontological Resources	Land Use			Visual Resources					Traditional Cultural Places						
																							Hopi			
			100-Year Floodplain Crossings	Number of Springs Within One-mile Corridor	Perennial Streams (number crossed)	Soils	Vegetation	Special Status Plants	Wildlife	Special Status Wildlife	Paleontological Resources	Existing Land Use	Future Land Use	Parks, Preservation, and Recreation	Views from Residences	Scenic Quality	Views from High Sensitivity Roads	Views from Moderate Sensitivity Roads	Views from Recreation Areas	Archaeology and History[1]	Number of Special Status Sites	Navajo	Ritual Places[2]	Nonritual Places[2]	Hopi Impact Score	Hualapai
GC1	260.6	H	--	--	--	--	--	--	--	--	--	--	--	--	[illegible]	[illegible]	[illegible]	--	--	--	--	[illegible]	[illegible]	[illegible]	**185**	--
		M	--	--	--	15.0	0.3	--	--	--	15.3	--	1.7	--	45.4	6.6	19.8	10.1	3.2	96.8	--	168.2	36	6		--
		L	2.2	12	1	245.6	260.3	3.4	62.6	16.7	245.3	260.6	5.3	3.6	189.4	239.5	239.6	250.5	257.4	163.8	1	83.0	--	--		--
K1	244.7	H	--	--	--	--	--	--	--	--	--	--	--	--	[illegible]	[illegible]	[illegible]	--	--	--	--	[illegible]	[illegible]	[illegible]	**168**	--
		M	--	--	--	16.8	0.3	--	--	--	17.1	--	--	--	57.2	5.0	7.8	10.1	3.2	112.3	--	161.9	32	6		--
		L	2.0	10	1	227.9	244.4	3.4	62.6	16.7	227.6	244.7	--	3.6	163.1	224.9	235.7	234.6	241.5	132.4	1	73.4	--	--		--
C1	186.7	H	--	--	--	--	--	--	--	--	--	--	--	--	[illegible]	--	--	--	--	--	--	[illegible]	[illegible]	--	**134**	--
		M	--	--	--	2.5	--	0.1	--	--	2.3	--	--	--	16.0	6.3	1.5	--	1.3	76.8	1	107.7	63	5		--
		L	4.1	12	1	184.2	185.8	2.8	103.9	2.4	184.4	186.7	21.8	2.1	170.1	180.4	185.2	186.7	185.4	109.9	3	5.0	--	--		--
C2	211.0	H	--	--	--	--	--	--	--	--	--	--	--	--	[illegible]	--	--	[illegible]	--	--	--	[illegible]	[illegible]	--	**169**	--
		M	--	--	--	3.0	--	--	--	--	4.5	--	--	--	49.2	28.2	--	6.6	1.3	91.4	1	163.7	65	4		--
		L	3.6	12	1	208.0	211.0	3.4	87.5	8.5	206.5	211.0	21.8	3.6	138.0	182.8	211.0	203.3	209.7	119.6	1	1.3	--	--		--

Numbers represent miles crossed unless otherwise indicated.

[1] Assumes helicopter construction in unroaded, high sensitivity zones.

[2] High impacts assigned to places that could be crossed, moderate impacts to other places in six-mile study corridor.

High Residual Impact

Summary of Impacts

Eastern Area Alternatives

Navajo Transmission Project

Table 2-12

Alternative Routes		Length	Impact Level	NATURAL ENVIRONMENT: Water Resources: 100-Year Floodplain Crossings	Water Resources: Number of Springs Within One-mile Corridor	Water Resources: Perennial Streams (number crossed)	Soils: Soils	Biological Resources: Vegetation	Biological Resources: Special Status Plants	Biological Resources: Wildlife	Biological Resources: Special Status Wildlife	Paleontological Resources: Paleontological Resources	HUMAN ENVIRONMENT: Land Use: Existing Land Use	Land Use: Future Land Use	Land Use: Parks, Preservation and Recreation	Visual Resources: Views from Residences	Visual Resources: Scenic Quality	Visual Resources: Views from High Sensitivity Roads	Visual Resources: Views from Moderate Sensitivity Roads	Visual Resources: Views from Recreation Areas	CULTURAL ENVIRONMENT: Archaeology & History[1]	Number of Special Status Sites	Traditional Cultural Places: Navajo	Traditional Cultural Places: Hopi: Ritual Places[2]	Hopi: Nonritual Places[2]	Hopi: Hopi Impact Score	Traditional Cultural Places: Hualapai
Moenkopi to Marketplace	N1W	217.0	H	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--
			M	--	--	--	2.7	--	--	--	0.2	4.2	--	--	--	0.6	--	1.4	--	0.6	--	1	24	1	1		176
			L	9.4	2	1	214.3	217.0	2.7	139.8	58.7	212.8	217.0	8.8	23.2	216.4	217.0	215.6	217.0	216.4	217.0	--	67	--	--		--
	N2	225.1	H	--	--	--	--	--	--	--	--	--	--	--	--	2.6	8.1	1.1	--	0.3	--	1	--	--	--	3	[illegible]
			M	--	--	--	3.6	--	--	--	0.2	4.3	--	--	--	15.2	13.4	9.4	--	12.1	37.0	3	24	1	1		135
			L	10.2	3	1	221.5	223.4	2.7	148.3	58.5	220.8	225.1	9.6	23.2	207.3	203.6	214.6	225.1	212.7	188.2	--	67	--	--		--
	S2	247.7	H	-	--	--	--	--	--	--	--	--	--	--	--	10.2	--	5.1	1.7	3.1	--	1	--	1	1	6	[illegible]
			M	--	--	--	1.8	--	--	--	0.2	6.4	--	--	--	23.8	58.1	12.0	12.7	14.1	5.9	2	48	1	--		79
			L	5.7	2	1	245.9	246.6	6.8	113.3	45.5	241.3	247.7	39.0	23.2	213.7	189.6	230.6	233.3	230.5	241.8	3	--	--	--		--
Moenkopi to Mead	N3	199.3	H	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--
			M	--	--	--	0.9	--	--	--	--	3.8	--	--	--	0.6	--	--	--	0.6	--	1	24	1	1		175
			L	8.9	1	1	198.4	199.3	2.7	140.4	49.1	195.5	199.3	--	16.3	198.7	199.3	199.3	199.3	198.7	199.3	--	67	--	--		--
	N4	207.4	H	--	--	--	--	--	--	--	--	--	--	--		2.6	8.1	1.1	--	0.3	--	1	--	--	--	3	[illegible]
			M	--	--	--	1.8	--	--	--	--	3.9	--	--	--	15.2	13.4	8.0	--	12.1	37.0	3	24	1	1		133
			L	9.7	2	1	205.6	205.7	2.7	148.9	48.9	203.5	207.4	0.8	16.3	189.6	185.9	198.3	207.4	195.0	170.5	--	67	--	--		--
	S4	230.0	H	--	--	--	--	--	--	--	--	--	--	--		10.2	--	5.1	1.7	3.1	--	1	--	1	1	6	[illegible]
			M	--	--	--	--	--	--	--	--	6.0	--	--	--	23.8	58.1	10.6	12.7	14.1	5.9	2	48	1	--		78
			L	5.2	1	1	230.0	228.9	6.8	113.9	35.9	224.0	230.0	30.2	16.3	196.0	171.9	214.3	215.6	212.8	224.1	3	--	--	--		--

Numbers represent miles crossed unless otherwise indicated.

[1] Assumes helicopter construction in unroaded, high sensitivity zones.

[2] High impacts assigned to places that could be crossed, moderate impacts to other places in six-mile study corridor.

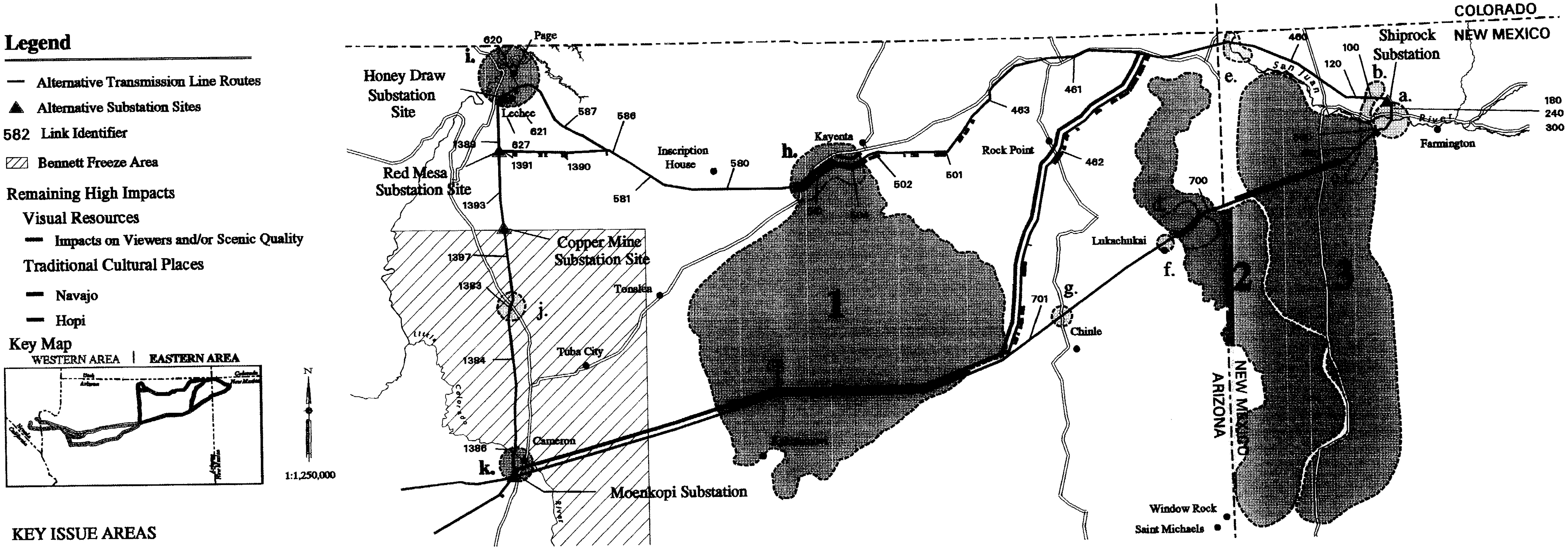
8.1 High Residual Impacts

Summary of Impacts

Western Area Alternatives

Navajo Transmission Project

Table 2-13



KEY ISSUE AREAS

Areas where key issues could not be wholly resolved at this stage of the project are shown in red.

Regional Areas

1. **Black Mesa:** An area of traditional Navajo and Hopi cultural significance and customary land use, including portions of the Marsh Pass Area. Impacts on traditional cultural places would be high.

2. **Chuska Mountains:** An area of traditional Navajo cultural significance and customary land use and biological concern. Impacts on traditional cultural places would be high. Impacts on sensitive species and big game habitat would be mitigated by paralleling the existing transmission line; limiting new access, tree clearing, and ground disturbance; and adhering to ESA Section 7 requirements.

3. **Chuska Valley:** An area of traditional Navajo cultural significance and customary land use. Impacts on traditional cultural places would be high.

Local Areas

a. **Town of Waterflow, San Juan River Valley:** Impacts on residences, agriculture, and the San Juan River would be mitigated by paralleling existing facilities, judicious placement of towers, and spanning sensitive features.

b. **The Northern Hogback Area:** Impacts on sensitive plants and the ACEC would be mitigated by limiting access, specifying construction practices, and spanning sensitive areas in an existing corridor. This crossing of The Hogback rather than the southern area is preferred by the BLM.

c. **The Southern Hogback Area:** Impacts on The Hogback National Register District, Chaco Protection Site, and sensitive plants would be mitigated by avoidance, limiting access, specifying construction practices, visual mitigation measures, and spanning sensitive areas.

d. **Buffalo Pass:** Impacts on biological resources (sensitive species and habitat, timber management, and Class A scenery) would be mitigated by paralleling the existing 500kV line, specifying construction practices, limiting access and tree clearing, matching stuctures, using nonspecular conductors, and adhering to ESA Section 7 requirements.

e. **San Juan River Crossing:** Impacts on proposed critical habitat for special status fish species and riparian areas would be mitigated by spanning the river and riparian habitat, and specifying construction practices in the existing utility corridor.

f. **Lukachukai:** Proximity to the town and residences. Impacts would be mitigated by using the existing utility corridor and judicious placement of towers.

g. **Chinle Valley, Many Farms:** Impacts on agricultural lands and existing residences would be mitigated by judicious placement of towers and spanning of cultivated lands in the existing utility corridor.

h. **Marsh Pass/Northern Black Mesa:** Navajo and Hopi traditional cultural places, Class A Scenery, residential views, archaeological resources, raptor habitat, and soil erosion. Impacts on traditional cultural places would be high. Visual impacts would remain high in certain areas, but would be reduced overall through the use of nonspecular conductors, dulled tower finishes, and judicious placement of towers. Archaeological, biological, and soil impacts would be mitigated by limiting access, constructing using helicopter, spanning sensitive areas, and judicious placement of towers.

i. **Page and Lechee Area:** Proximity to Lechee and outlying residences, existing recreational use, future development plans, and visual concerns. Impacts would be partially mitigated by locating this alternative in a new corridor that would cross the edge of the city, judicious placement of towers, and visual mitigation measures. Planned open space and industrial areas could not be avoided.

j. **The Gap:** Potential land use impacts would be mitigated by locating facilities between two existing transmission lines and spanning water-treatment ponds.

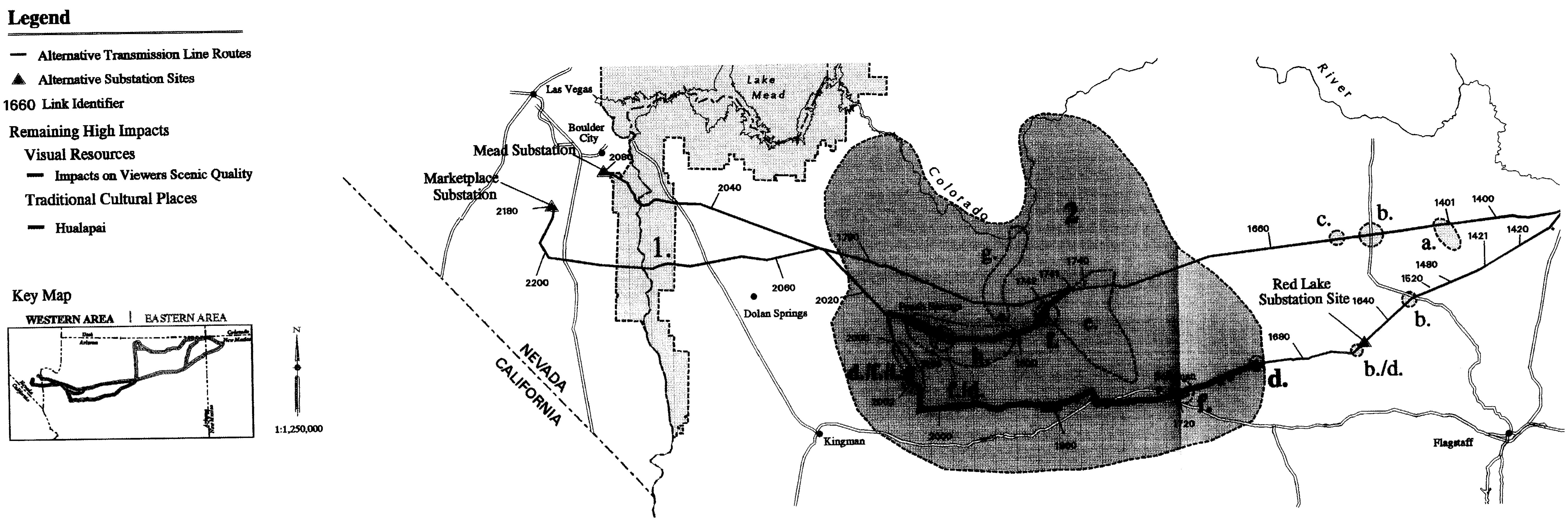
k. **Cameron:** Using existing corridors and judicious placement of towers would reduce site-specific impacts; however, the cumulative effects of multiple transmission lines and restrictions on future land use would remain.

Issues Areas

Eastern Area Alternatives

Navajo Transmission Project

Figure 2-12



KEY ISSUE AREAS

Areas where key issues could not be wholly resolved at this stage of the project are shown in red.

Regional Areas

1. Lake Mead NRA: Two alternative routes cross the Lake Mead NRA and Colorado River. Areas east and west of the river provide sensitive habitat for desert bighorn sheep, desert tortoise, and nesting bald eagles along the river. The Lake Mead NRA is an important recreational amenity. Impacts in this area would be mitigated by locating the alternatives in designated utility corridors, specifying construction practices, spanning the river, and using measures to reduce visual impacts. The NPS prefers the southern river crossing because the terrain is less rugged, there is less sensitive habitat, and there is only one existing line crossing the river. However, the access road along the northern route (Link 2040) has recently been upgraded and parts of Link 2060 are rugged and require upgrading.

2. Vicinity of the Hualapai Indian Reservation: An area of traditional Hualapai cultural significance. Impacts would be high along new corridors in this area.

Local Areas

a. Arizona Trail and Moqui Stage Station: Historic features at this location provide interpretative and recreational opportunities where impacts on views would be mitigated by using an existing utility corridor, nonspecular conductors, and judicious placement of towers.

b. US 180/AZ 64: This travel route provides access to the south rim of the Grand Canyon. Visual impacts would be mitigated by using nonspecular conductors and judicious placement of towers, and spanning this road within an existing utility corridor.

c. Grand Canyon Railroad: Visual impacts at the crossing of this historic railroad would be mitigated by using non-specular conductors and judicious placement of towers, and spanning the railroad within an existing utility corridor.

d. Beale Wagon Road: Visual and cultural impacts at the crossing of this historic trail would be mitigated in areas where an existing corridor is used. In areas of new corridor, at Russell Tank and on the Truxton Plain, visual impacts would be high.

e. Aubrey Valley - Black-footed Ferret Management Area: The FWS has initiated the reintroduction of a nonessential, experimental population of black-footed ferret in this area. The most critical areas have been avoided and the remaining alternatives are located near the edge of the reintroduction area or are located within an existing utility corridor. Impacts would be mitigated by specifying construction practices and timing, and limiting access.

f. Historic Route 66: Route 66 would be crossed in a new corridor resulting in high impacts on highway views at four locations, and also would result in high impacts on cultural resources at the crossing in the Truxton Plain area.

g. Diamond Creek Road: This road provides limited access to the Colorado River and Grand Canyon. Visual impacts would be mitigated by using nonspecular conductor and judicious placement of towers in the existing corridor, and matching structures.

h. Truxton Plains: BLM has expressed concern for impacts on visual quality, big game habitat, and highly erosive soils in this area. Impacts on soils and fragmentation of big game habitat would be mitigated by specifying construction practices and limiting access. Impacts on visual quality would be reduced by mitigation measures; however, a small amount of high residual impact would remain in crossing the Music Mountains.

i. Hackberry: Potential land use impacts in and around the town of Hackberry would be mitigated by selecting an alternative route that avoids the community; however, high impacts on residential viewers and viewers on Route 66 would remain.

Issues Areas

Western Area Alternatives

Navajo Transmission Project

Figure 2-13

CORRIDOR CHARACTERISTICS				ENVIRONMENTAL FACTORS AND PREFERENCE: NATURAL				HUMAN		CULTURAL			Traditional Cultural Places						
ALTERNATIVE ROUTES	Overall Length (miles)	Existing Transmission Line Corridor* (miles and percent)	New Transmission Line Corridor* (miles and percent)	Paleontology	Water Resources	Soils	Biology	Land Use	Visual Resources	Archaeology and History	Special Status	**Preference without TCPs**	Navajo	Hopi	Hualapai	**TCP Preference**	**Combined Preference**	**Overall Environmental Preference**	SUMMARY EXPLANATION
Glen Canyon 1 (GC1)	260.6	210.9 (81%)	49.7 (19%)	2	1	2	1	2	3	2	1	3	1	3	-	2	3 / 2	2	Being north of the Chuska Mountains and Black Mesa, GC1 avoids many sensitive traditional cultural places, and other areas of significant impact in the Chuska Valley, Chuska Mountains, and southern portion of Black Mesa. High impacts on visual resources would occur primarily along new corridor located south of Kayenta in the Marsh Pass area, a route that avoids Monument Valley. GC1 crosses short distances of areas designated for future industrial development and open space in the Page and Lechee areas. The northern crossing of The Hogback ACEC on this route is preferred by the BLM.
Kaibito 1 (K1)	244.7	178.8 (73%)	65.9 (27%)	2	1	2	1	1	3	2	1	2	1	2	-	1	2 / 1	1	K1, although similar to GC1, is considered the overall environmentally preferred route. This route is approximately 16 miles shorter than GC1 and would avoid potential future land use impacts in the Page and Lechee areas. K1 also ranked second preference for Hopi traditional cultural places over the third place ranking for GC1. The northern crossing of The Hogback ACEC on this route is preferred by the BLM.
Central 1 (C1)	186.7	176.3 (94%)	10.4 (6%)	1	1	1	2	1	1	1	2	1	3	1	-	4	1 / 4	4	C1 parallels an existing 500kV transmission line for a greater distance than any of the other eastern area alternative routes. Consequently, impacts on most resources would be minimized. However, it is the least preferred overall for the following reasons. Adverse impacts on cultural traditional places would be very high crossing the Chuska Valley, Chuska Mountains, and southern portion of Black Mesa. Also, it is the least preferred for biological resources because of concerns in the Chuska Mountains. Based on input from the Navajo Historic Preservation Department and Fish and Wildlife Department, the Chuska Mountains area is considered a unique and an important feature and resource within the boundaries of the Navajo Reservation.
Central 2 (C2)	211.0	145.3 (69%)	65.7 (31%)	1	1	1	1	1	2	1	2	1	2	2	-	3	1 / 3	3	C2 avoids the Chuska Valley and Chuska Mountains; thereby avoiding high adverse impacts on traditional cultural places in those areas. However, C2 crosses sensitive traditional cultural places located on the southern portion of Black Mesa. C2 parallels the least distance of existing transmission lines. High impacts on visual resources would occur selectively along the new corridor in the vicinity of Sweetwater, Carson Mesa, and Chinle Valley. The northern crossing of The Hogback ACEC on this route is preferred by the BLM.

Summary Key

1 Most preferable
2
3
4 Least preferable

High impacts on these resources remain after mitigation for a portion of the alternative route.

Notes:

- * May include portions of existing pipeline and/or fiber optic line corridor
- TCP – Traditional cultural places
- Appendix A provides a table summarizing the comparison of alternatives for each resource.

Preference Summary
Eastern Area Alternatives

Navajo Transmission Project

Table 2-14

		Corridor Characteristics			Environmental Factors and Preference															
					Natural				Human		Cultural			Traditional Cultural Places						
	Alternative Routes	Overall Length (miles)	Existing Transmission Line Corridor* (miles and percent)	New Transmission Line Corridor* (miles and percent)	Paleontology	Water Resources	Soils	Biology	Land Use	Visual Resources	Archaeology and History	Special Status	**Preference without TCPs**	Navajo	Hopi	Hualapai	**TCP Preference**	**Combined Preference**	**Overall Environmental Preference**	Summary Explanation
Moenkopi – Marketplace	Northern 1 (N1W)	217.0	217.0 (100%)	–	1	1	1	1	1	1	1	1	**1**	1	1	1	**1**	1 / 1	**1**	N1W parallels existing transmission lines for its entire length, would avoid high impacts, and is a first preference for all resources and the overall first preference. N1W is first preference for traditional Hualapai cultural places–impacts would be only moderate because it parallels existing facilities. N1W avoids issues associated with the development of new corridor in the Truxton Plain, Seligman, and Hackberry areas; and high visual impacts associated with the crossing of historic U.S. Route 66, the Music Mountains, the Beale Wagon Road, and scattered rural residences.
	Northern 2 (N2)	225.1	183.6 (82%)	41.5 (18%)	2	1	2	3	2	2	3	2	**2**	1	1	2	**2**	2 / 2	**2**	N2 would require approximately 60 miles of new transmission line corridor along the edge of the Aubrey Valley and across the Truxton Plain and Music Mountains. N2 was ranked first or second for all resources with the exception of biology, and archaeology and history; however, impacts associated with these resources could be mitigated. High impacts would remain on scenic quality, views from residences, and historic U.S. Route 66 as well as on Hualapai traditional cultural places.
	Southern 2 (S2)	247.7	161.4 (65%)	86.3 (35%)	3	1	3	2	3	3	2	3	**3**	2	2	3	**3**	3 / 3	**3**	S2 is the longest of the routes from Moenkopi to Marketplace, would require approximately 89 miles of new transmission line corridor, and also would result in the greatest amount of high impact. High impacts on views from residences in the Seligman and Hackberry areas, views from high and moderate sensitivity roads including U.S. Route 66, and views from recreational areas or trails such as the Beale Wagon Road could result. S2 would result in the greatest amount of high impact on Hualapai traditional cultural places.
Moenkopi – Mead	Northern 3 (N3)	199.3	199.3 (100%)	–	1	1	1	1	1	1	1	1	**1**	1	1	1	**1**	1 / 1	**1**	Among the Moenkopi-to-Mead alternatives, the preference rankings for N3, N4 and S4 are the same as those described above for N1W, N2, and S2. The primary difference between the alternative routes into Marketplace and Mead is that the alternative routes into Mead would parallel two existing lines across the Colorado River and Lake Mead NRA in a rugged canyon setting along the recently constructed Mead-to-Phoenix 345kV line, which has an upgraded access road; whereas the alternative routes into Marketplace parallel a single transmission line to the south, across the river in an area of more moderate terrain. NPS has expressed a preference for the southern crossing based on the number of existing lines, terrain, construction difficulty, and higher quality desert tortoise habitat associated with the northern crossing.
	Northern 4 (N4)	207.4	165.9 (80%)	41.5 (20%)	2	1	2	3	2	2	3	2	**2**	1	1	2	**2**	2 / 2	**2**	
	Southern 4 (S4)	230.0	143.7 (62%)	86.3 (38%)	3	1	3	2	3	3	2	3	**3**	2	2	3	**3**	3 / 3	**3**	

Summary Key

1 Most preferable
2 ↑
3 ↓
4 Least preferable

High impacts on these resources remain after mitigation for a portion of the alternative route.

Notes:

- * May include portions of existing pipeline and/or fiber optic line corridor
- TCP – Traditional cultural places
- Appendix A provides a table summarizing the comparison of alternatives for each resource.

Preference Summary
Western Area Alternatives

Navajo Transmission Project

Table 2-15